THE ELEMENTS OF HYGIENE FOR SCHOOLS

ISABEL McISAAC

HYGIENE

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THE ELEMENTS OF HYGIENE

FOR SCHOOLS

COMPILED BY

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TEACHERS' PREFACE

It has been the aim of the compiler to present the subject of hygiene in such a way that it may be of practical everyday use to the large number of pupils who will have no further opportunity for study of the subject.

The chapter on Bacteria may be thought unnecessary; but the relations of bacteria not only to disease but to housekeeping, farming, and many other industries are of increasing importance, and the time fast coming when a whole text-book and not a single chapter will be devoted to bacteriology in all schools.

It may be thought also that too much space has been devoted to the hygiene of occupation; but the subject is one of vital importance to the nation as well as the individual and it daily becomes more difficult to separate the physical conditions from the social conditions in all questions of hygiene. The writer would suggest the following additional helps to a better understanding of the subjects.

Chapter I. Lecture with microscopical and blackboard illustrations, by Medical Inspector or other doctor.

Chapter II. Demonstration of difference in well and badly cooked foods, especially bread, pastry, cereals, and overcooked meats. Show fresh and wilted vegetables, and good and bad meats.

If no dietitian is available, the demonstration may be easily done by any teacher.

CHAPTER III. System of ventilation in the school building, with blackboard illustrations and by inspection of the apparatus.

CHAPTER IV. Sketch plan of water system of the home city upon the blackboard, stating method of filtration or other means of purification employed and allowance per capita.

Reports of the condition of the water supply may be obtained from the Boards of Health in most cities.

Give demonstration of domestic filters.

Dealers in filters are usually very glad to give demonstrations.

CHAPTER V. Discuss plan of disposal of sewage and garbage in home city; also plumbing of the school building.

CHAPTER VI. Two or more lectures or talks by the Medical Inspector or School Nurse upon the most common contagious diseases: scarlet fever, diphtheria, and tuberculosis.

1. PREVENTIVE MEDICINE:[1]

Examples. — Vaccination to prevent smallpox; boiling impure water to prevent typhoid.

2. TUBERCULOSIS:

A. Cause: tubercle bacillus.
   1. Where found.
   2. Portals of entry.
   3. Predisposing factors.

B. Prevention: healthy bodies.
   1. A simple rule of hygiene.
   2. Necessity of a pure milk supply.
   3. Disposal of sputum.
   4. Enforcement of anti-spitting laws.

[1] Antituberculosis Work in Pittsburgh Schools, Bertha L. Stark, R.N. International Congress on Tuberculosis, Washington, D.C. October, 1908.

5. Disinfection of homes.
6. Best ways of sweeping and dusting.
7. Laws which make for a healthier city.
8. Dangers in the use of patent medicines.
9. Phthisiophobia — the harm it does.

REFERENCES FOR TEACHERS: The Story of Germ Life, by Prof. H. W. Conn.

Principles of Bacteriology, by A. C. Abbott, M.D.

Hygiene and Sanitation, by Seneca Egbert, A.M., M.D.

Practical Hygiene, by Charles Harrington, M.D.

Principles of Hygiene, by D. H. Bergey, A.M., M.D.

Hygiene of Transmissible Diseases, by A. C. Abbott, M.D.

INTRODUCTION

Hygiene is the science which treats of the laws of health; of man's habits and surroundings to determine how far they are helpful or harmful to his physical welfare.

During the past fifty years men have turned their attention more to the cause and prevention of disease than to its cure by medicine, and have found that most disease is caused by wrong habits of living and therefore preventable.

For this reason the study of hygiene is taken up in our schools that the young may early understand how by the observance of simple rules they may keep their vigor of mind and body.

It is not necessary for us all to study hygiene as a doctor must do, but if we gain an intelligent idea of how food, air, water, drainage, clothing, occupation, and exercise may affect our health, we can avoid those habits and surroundings which are injurious.

This does not mean that we should be constantly asking ourselves if we are well, nor giving ourselves up to morbid fears of illness; but that we should observe simple, cleanly, moderate habits which will give us that perfect health whereby we may do our work and our play too without anxiety about our health.

When we are young, the thought that feeble health will interfere with our work does not seem such a great

hardship and we do not realize that impaired health also interferes with our pleasures as well, which is perhaps as great a hardship, for work and play are both needed for the old as well as the young, and nothing takes away our zeal for work and our enjoyment of healthy amusements and recreation as impaired health. With vigorous health work is interesting, while with feeble bodies work becomes worse than drudgery and life a burden.

The physical habits we form in youth make or mar the foundations of our health for the rest of our lives.

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CHAPTER I

BACTERIA

BACTERIA is a general term for the lowest form of vegetable micro-organisms.

The word "bacteria" conveys to most people only an idea of contagious disease, which is erroneous and unfortunate, because the rôle played by most bacteria is beneficial to man, and the most interesting facts about them are the wonderful part they take in the processes of nature.

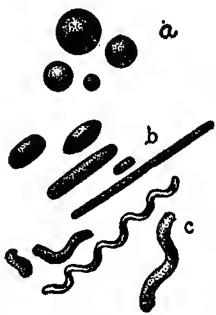


FIG. 1. — General shapes of bacteria: *a*, Spherical forms; *b*, Rod-shaped forms; *c*, Spiral forms.

Before taking up the study of their powers we must first consider their shape, size, habits, and where they are found.

Shape. — Although there are hundreds of different species of bacteria, there are only three general forms, — spheres, rod-shaped, and spirals, which Professor Conn compares to billiard balls, lead pencils, and corkscrews.

The spheres may vary in size, the rods in length, and the spirals have one or many coils, but in all of the variations the general form remains spheres, rods, or spirals.

Those which are spherical in shape are known as *micrococci,* the rod-shaped as *bacilli,* and the spirals as *spirilla.*

Bacteria which live best with air are known as *aërobic,* and those which live best without air are *anaërobic.*

FIG. 2. — Micrococci.

Bacteria are also classified as those which live upon dead organic matter, called *saprophytes,* and those which may exist in living organic matter, called *parasites* or *pathogenic* bacteria.

Size. — All bacteria are extremely minute and are never visible to the naked eye. It is said their size averages .00001 inch, and they are the smallest living organisms the microscope has revealed.

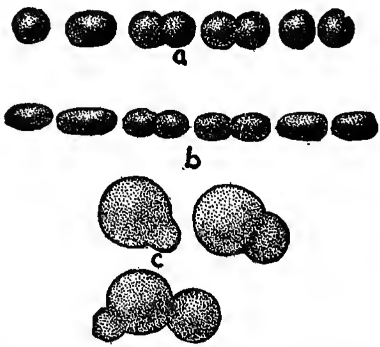


FIG. 3. — Method of multiplication of bacteria: *a* and *b*, Bacteria dividing by fission; *c*, A yeast multiplying by budding.

Multiplication. — Bacteria multiply by fission, or splitting into two parts, each part in turn dividing again in the same manner. It is this power of multiplication by fission which makes bacteria of such significance; their minute size would make them ineffectual or harmless were it not for their extraordinary power of multiplication, which is almost incredible in its rapidity.

Some of the species which have been watched under

the microscope under favorable conditions have been found to divide every half hour or in less time, and thus a single bacterium might produce millions in twenty-four hours; and if their multiplication was not checked, at the end of a year their numbers would be beyond our powers of expression. These figures interest us because they make us realize that in bacteria there is a force of mighty strength.

However, long before the offspring have reached even into the millions their multiplication is checked, either by lack of proper food, or by the effects of their own excreted products, which are injurious to them.

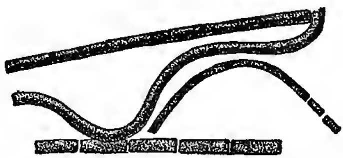


FIG. 4. — Rod-forms united to form chains.

Food. — Bacteria differ from most other vegetable growths in the food they live upon. Most plants make their own food by extracting the substances they need from the soil and air, but bacteria subsist upon the same substances which are already prepared by the life of the animal or plant, and for this reason the bacteria can grow much more rapidly than other vegetation, as they are not obliged to make their own food as other plants, nor to hunt for it as the animals, but living in the midst of prepared food, this multiplication is limited only by their power to assimilate it.

Chemical Changes. — As bacteria grow in masses (called colonies) in food, they cause certain chemical changes to take place in it, and these chemical changes and the marvelous rapidity of their multiplication make it easy for us to understand the transformation they

may bring about wherever they gain a favorable foothold and begin to grow.

Where Found. — Bacteria are found everywhere; no other vegetables or animals are so universal. They are in the soil to a depth of about four feet, the amount varying from a few hundreds to hundreds of millions when the soil is moist and full of organic matter; they are found at a considerable depth in the ocean; all fresh water contains them; they are in the air, particularly in cities and towns, their greatest number being near the surface of the earth and decreasing in the higher altitudes. Anything which raises the dust increases the bacteria in the air, while the dust and emanations from the clothing and bodies of persons in a close room fill the air with bacteria. It is supposed that bacteria are carried through the air only by becoming adherent to particles of dust, hence the great danger of any accumulation of dust which might carry the bacteria of disease.

Bacteria are found in greatest abundance in decaying vegetable and animal matter wherever it may be, in decaying wood and foliage, in dead bodies of all animals, in manure heaps, and in filth and slime they find their best nourishment. The bodies of both men and animals contain bacteria, they being found especially in the mouth, stomach, and intestines. On the surface of the body in the minutest crevice of the skin, upon the hair, under the finger nails, and upon the clothing they cling in great numbers, but they are *never found in the tissue of a healthy person*, either in the blood, muscle, gland, or any other organ.

The secretions, such as saliva, contain them; for while

the healthy gland itself contains no bacteria, they do exist in the ducts which convey the secretions to the exterior of the body, and thus the secretions are always contaminated by them.

The bodies of insects and other lower animals are more or less covered with bacteria; in fact, wherever there is a lodging place for dust, bacteria will be found.

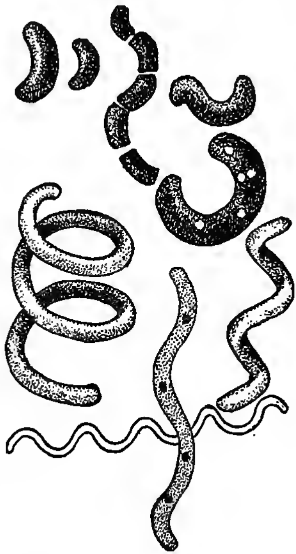


FIG. 5. — Various types of spiral bacteria.

Although bacteria are found in so many places they are usually dormant or growing very little; when dried as dust, they are wholly dormant, and those contained in pure water multiply very slowly; but every single bacterium or its spore has the power of multiplication as soon as it falls into a favorable place where there is moisture and food for it. Their inconceivable power of multiplication being held in check by lack of food, then when favorable food, moisture, and temperature are furnished them, their possible powers at once become a mighty reality. Such food is provided by the dead bodies of animals, plants, and by animal secretions and some other sources. We have learned that bacteria are present everywhere except in the tissues of healthy men and animals, but there are a few species which are capable of existing and growing

for some time in the living tissues, and these are known as the disease-producing bacteria.

The large majority of bacteria are capable of living only upon dead organic matter. These are known as *saprophytes*, and by digestion-like processes, known as putrefaction, they break up the complex chemical molecules of the dead animal or plant bodies into simpler molecules capable of again being used by growing plants to form the starches, sugars, etc., of the plant tissues, which in turn serve for food for men and animals.

This transfer of the simpler chemical substances, such as water, carbon dioxide, and the nitrates into the complex chemical substances of plant tissues and from them into the more complex substances of the animal tissues, and back into the simpler compounds which may again be used by plants for food, is known as the *food cycle*, and it is in the completion of this cycle that bacteria play such an important part, a rôle so important that the continuance of life upon the surface of the earth would be impossible if bacterial activity were checked for any length of time.

Scavengers. — Bacteria act as scavengers; by their action upon dead organic matter, as described in the food cycle, foul, offensive materials are transformed into harmless, simple substances which are taken up by the soil and thus furnish food for vegetation. Knowing this, we can easily understand how life would be impossible if all dead animals and plants did not succumb to these changes, but were left to accumulate upon the face of the earth.

It was formerly thought these changes, called putre-

faction, were wholly chemical; but it is now known they are due to the action of bacteria, and thus we know that bacteria are necessary to keep the earth clean and fresh, that life may continue.

Fertilization of the Soil. — Another part equally important which is accomplished by bacteria is in the renewal or fertilization of the soil.

Plants and animals both require food, and plants, while obtaining some of it from the air, receive most of their nourishment from the soil. How can the soil go on furnishing food to vegetation indefinitely? Why is the supply of carbon, hydrogen, and oxygen, which are the elements which must be contained in all foods for either plants or animals, not exhausted? How can the soil continue to support plants for thousands of years and yet remain fertile?

Plants must not only have carbon, hydrogen, and oxygen for food, but these elements must be in the form suitable for their use. A man may be fed upon roast beef and potatoes, but one would not think of giving such a diet to an apple tree, although the beef and potatoes contain all the elements necessary for nourishing the apple tree; but they are not in the form suitable for the plant and must be rearranged by the breaking up of the complex substances before the plant can use them, and here we have the beginning of the work by the bacteria upon the never ending *food cycle.*

The compounds known as albumins, sugars, and starches in the dead organic matter are broken up by the bacteria into simpler elements, such as carbon dioxide, water, and the nitrates, before the plant can use them; and thus in their first work as scavengers the bacteria

return to the soil all of the elements needed by the plants, and we say that the soil has been fertilized or fed.

This is the chief work of bacteria, and all but a very few species are engaged solely in this marvelous process which makes life possible on the face of the earth. However, the bacteria do not discriminate in their choice of food, but will attack the milk, meat, eggs, vegetables, etc., that we wish to preserve for our own use with the same energy that they work upon decaying leaves in the garden; and for this reason we have ice boxes, and food is canned to preserve it. All food contains bacteria, but if put into the ice box when fresh, the low temperature prevents their growth temporarily.

FIG. 6. — *Bacillus acidi lactici*, the common cause of sour milk.

When food is canned, it is cooked until it is sterilized, *i.e.* long enough to destroy all bacteria; the cans and other utensils are also sterilized, and the cans are sealed while the food is boiling hot.

Milk is more easily contaminated by bacteria than any other article of food, hence the precaution necessary in the care of all utensils used for milk.

FIG. 7. — Dairy bacterium producing pleasant flavors in butter. This species has been used commercially for the ripening of cream.

The changes produced in food by the action of bacteria usually render it unfit for use, but there are notable exceptions to this rule.

Many of our valuable foods owe their delicious flavor or aroma to bacterial products; this is especially true in

butter, cheese, bread, wines, vinegars, and substances used for flavoring purposes.

In the large creameries where most of our best butter is made the butter makers have learned to inoculate the cream with certain kinds of bacteria which are known to produce good-flavored butter, just as the baker inoculates the dough with some good yeast to produce palatable bread.

FIG. 8. — *Diphtheria bacillus.*

Bacteria also play an important part in many other industries; in the manufacture of linen from flax, in the tanning of hides for leather, etc.

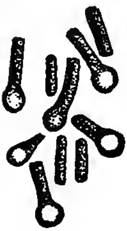


FIG. 9. — *Tetanus bacillus.*

Disease-producing (pathogenic) Bacteria. — We now come to the consideration of the few species which are capable of growing in living tissues and are known as disease-producing or pathogenic bacteria.

These number about fifteen, not including a number which are peculiar to tropical climates and are unknown in the United States.

The disease-producing bacteria may be found in dead organic matter, in dust, in impure water, milk, or any other food, but when taken into the body, are *capable of growth in the living tissues* and thus produce disease. These bacteria produce a poisonous substance which destroys living organic matter, such as the cells which go to make up the blood, muscles, brain, and other organs, or alters

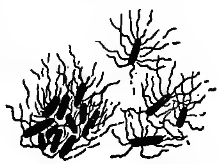


FIG. 10. — Bacillus of typhoid fever, showing flagella (means of motion).

them in such a way that they are no longer capable of doing their proper work in the body.

These bacterial poisons are known as toxins and are the most powerful of known poisons.

Experiments have been made by introducing the bacilli of diphtheria, for instance, into carefully prepared bouillon (beef tea), and after keeping it at the proper temperature for several days it has been found that the bacilli have grown very rapidly. The bouillon has then been filtered to remove all the bacteria, and the fluid is found to be highly poisonous, that is, the bouillon has been poisoned by the toxins secreted by the bacteria. An idea of the power of these toxins may be had when we learn that one cubic inch of this bouillon contains enough poison to kill 7000 guinea pigs, and the toxins produced by some other bacteria, the bacilli of tetanus (lockjaw), for instance, is said to be from 500 to 2000 times stronger than strychnine.

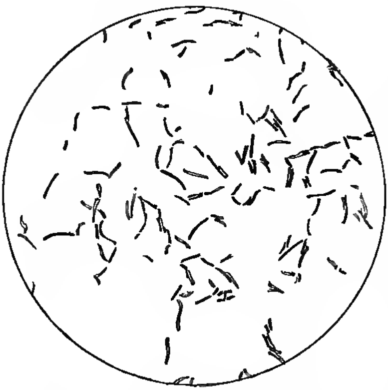


FIG. 11. — Tubercle bacilli, × 1000.

If a man takes into his system a sufficient quantity of alcohol, there is produced a condition known as *intoxication,* which we recognize as the disease of drunkenness; and likewise if a small quantity of the filtered bouillon containing the toxin of diphtheria

should be injected into the healthy tissues of an animal, an intoxication characterized by certain symptoms would result which is recognized as diphtheria.

Thus we see that a disease due to bacteria is an intoxication resulting from the toxins produced by the bacteria.

In the case of alcoholic intoxication a certain definite amount is taken, which is quickly changed in the body or excreted, and the abnormal symptoms pass away in a few hours; but when the disease-producing bacteria gain access to the body and begin their growth and manufacture of toxins, there is an indefinite, perhaps an overwhelming, amount of poison to be overcome, and we ask what occurs to control the multiplication of bacteria? Why do they not continue to produce toxins which must eventually kill the patient?

The human body contains various cells and fluids which are a defense against bacteria. If the non-disease-producing bacteria are injected into healthy living tissue, they are destroyed in a few hours by these cells and fluids. When disease-producing bacteria gain access to the body, these cells and fluids have the power to produce substances which are poisonous to the bacteria, and thus a conflict rages between the bacteria on one side and the cells and fluids of the body on the other. If the patient was in a healthy condition when his body was invaded by the disease-producing bacteria and not weakened by dissipation, poor food, bad air, and other causes, the battle will be a short one and the bacteria will be destroyed before they gain a foothold. This is what occurs when we say that we have been "exposed" to a contagious disease

and did not "take" it, and is the best possible argument in favor of living moderate, hygienic lives, with no bad habits.

On the contrary, the cells of the body may not be in a condition to overcome the invading bacteria, or the bacteria may be more vigorous than usual, as is often the case if they have come directly from another person suffering from the disease. Thus the bacteria gain a foothold, and the person is overwhelmed by disease.

The presence of the bacteria stimulates the activity of the cells and fluids, and the life of the patient depends upon whether they are able to produce enough destroying substances to control or eliminate the bacteria. If they cannot, the patient dies. This neutralizing substance manufactured by the cells and fluids is known as *antitoxin.*

The conflict between the bacteria and the cells causes the symptoms — fever, loss of appetite and sleep, rapid pulse, and pain — which we see and recognize as evidence of disease and are the signs and signals whereby the doctor judges the progress of it.

In the following chapters of this little book will be found frequent references to bacteria in their relation to air, food, water, sewage, and garbage, as well as to human beings, and it is hoped that this slight sketch of them will help the student to a better understanding of the subjects and to realize that cleanliness is really the keynote of health.

If our habitations and our personal habits were always cleanly, the ravages of contagious diseases, which are very properly called "dirt diseases," would be reduced to a minimum instead of claiming millions of victims every year.

CHAPTER II

FOOD

PREPARATORY READING:[1] *The Process of Digestion and Absorption.*

FOOD supplies the needs of the human body in five ways:—

"1. It is used to form all the tissues of the body.

"2. It is used to repair the waste of all the tissues of the body.

"3. It is stored in the body for future use.

"4. It is consumed as fuel to maintain the constant temperature which the body must always possess in a state of health.

"5. It produces muscular and nervous energy." (Atwater.)

Food is usually divided into organic and inorganic substances.

The organic containing: Proteids,
Carbohydrates,
Hydrocarbons, or fats.

The inorganic containing: Water,
Salts of various kinds.

Each group has its own office in the body, and all are necessary in due proportion for the nutrition of the body, although in time of need any one of the divisions may supply for either of the others temporarily.

[1] To be found in any recognized text-book on Physiology.

"In general it may be said that the carbohydrates are used for the production of force and that the fats are stored in the body for fuel. The proteids do all that can be done by the fats and carbohydrates and in addition form the basis of blood, muscles, and all the connective tissues." (Kimber.)

The proteids are the most important constituent of both animal and vegetable foods, and between the two classes there is little chemical difference, their nutritive value being about equal. They are present in variable amounts in all vegetable and animal tissue.

The foods that are richest in the various forms of proteids are meat, milk, eggs, cheese, all kinds of fish, wheat, beans, and oatmeal.

Taken in excess the proteids may cause diarrhœa and albuminuria (albumin in the urine), while a deficiency will cause loss of strength and greatly lessened resistance to disease.

The fats are found in both animal and vegetable foods, such as the fat of meats, of milk, olive oil, and cotton-seed oil.

The carbohydrates include the starches, sugars, and cellulose, being found most plentifully in the cereals, as wheat, oats, rye, barley, corn; in the legumes, as peas and beans, and in the various root foods and tubers; as beets and potatoes.

The carbohydrates lessen the desire for fats, and taken in excess cause a great increase of fatty tissue in the body, and produce indigestion.

Certain *organic acids* are found in foods and are a necessary constituent for nutrition; their exclusion causing scurvy. The two most important acids are

citric and tartaric, the former found in lemons and oranges, and the latter mostly in grapes; lactic acid is found in milk; oxalic acid is found in spinach, tomatoes, strawberries, and rhubarb; acetic acid is the acid of vinegar; malic acid is found in apples, pears, and some other fruits.

The mineral elements of food include water, the chlorides, phosphates, sulphates, and other salts of sodium, potassium, and magnesium, besides some of the compounds of iron.

Chloride of sodium (common salt) is the most important, and deprived of it there is loss of weight of the body. The phosphates are necessary for the growth of bone, and to the nervous system; iron is needed for the hæmoglobin in the blood; deficiency of calcium and magnesium causes rickets.

Two thirds of the weight of the body is made up of *water*, and in consequence large quantities of fluid must be taken daily to take the place of that lost by the excretions.

A certain amount is necessarily taken in all forms of food, and beverages such as tea, coffee, milk, and other drinks, three pints daily being required for an adult, more in hot weather or when engaged in hard labor. An excess of cold water taken with meals impairs digestion, but the effects of a deficiency of fluid are much more serious, inducing disorders of the kidneys and bladder.

The reserve forces of the body are stored in the form of glycogen and fatty tissue.

Some of the end-products of carbohydrate digestion are reconverted in the liver into glycogen, which is given

out for heat and energy during the intervals between eating. Fothergill says, "The liver stores up from each meal so much glycogen, giving it off as required; otherwise life would be one long, dreary meal."

The fatty tissue is less available, and is called upon during prolonged deprivation from food.

"The *potential energy* of any food is measured by the amount of heat which can be obtained by its complete combustion, and is expressed in units or calories. . . .

"The amount of energy required to raise the temperature of a pound of water 1° F. has as a mechanical equivalent 772 units of work; that is to say, the same amount of energy will raise 772 pounds 1 foot."[1]

The combustion of carbohydrates and fats in the body is complete, but the proteids leave a residue of urea.

The amount of food necessary varies with the individual, the occupation, and the climate. In planning any dietary, not only the nutritive value but variety and individual taste need consideration; otherwise the appetite becomes impaired.

The constituents of the standard diets have been modified by the results of recent researches.

One writer says that the "American working man requires four ounces of proteids, two ounces of fats, and eighteen ounces of carbohydrates," which seems to be the proportion and quantities generally accepted by the best authorities.

In modifying the quantity to suit the individual it is essential that the proportion of 1 part nitrogen to 15 parts of carbon be maintained.

The amount of water needed varies from 2 to 3

[1] *Practical Hygiene*, Harrington.

pints daily, according to the climate, season, amount of work or exercise, and activity of the skin and kidneys.

The digestibility of food depends upon its nature, texture, hardness, and chemistry, as well as upon the quantity, whether mixed with other foods, thoroughness of mastication, and upon the condition of the digestive organs of the individual. Animal food is considered somewhat more digestible than vegetable; the fat meats less digestible than the lean, and the sugar and starch of vegetables capable of complete digestion *when properly cooked.*

Many years ago a Canadian workman named Alexis St. Martin received an injury to the stomach which would usually prove fatal, but the man recovered, with an opening into the stomach which enabled Dr. Beaumont to make a series of experiments and observations upon the process of digestion, which have been of remarkable value.

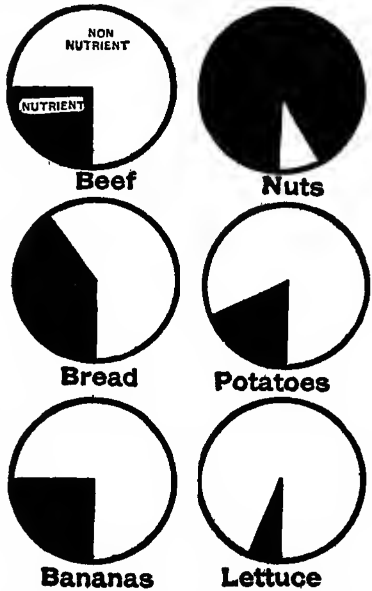


Fig. 12. — Amount of nourishment (black) and waste (white) in several foods.

It should be taken into consideration that the process of digestion, however, does not all take place in the stomach.

Dr. Beaumont's list of foods is arranged in the order

of their digestibility as follows: "Rice, tripe, whipped eggs, sago, tapioca, barley, boiled milk, raw eggs, lamb, parsnips, roasted and baked potatoes, and fricasseed chicken are most easily digested in the order given — the rice disappearing from the stomach in one hour, and the fricasseed chicken in two and three fourths hours.

"Beef, mutton, pork, oysters, butter, bread, veal, boiled and roasted fowls are rather less digestible — roast beef disappearing from the stomach in three hours and roast fowl in four hours. Salted beef and pork disappear in four and a quarter hours."

Chambers' list of the digestibility of foods is as follows: "Roast mutton, sweetbread, boiled chicken, venison, soft-boiled eggs, new toasted cheese, roast fowl, turkey, partridge and pheasant, lamb, wild duck, oysters, periwinkles, omelette, tripe, boiled sole, haddock, skate, trout, perch, roast beef, boiled beef, rump steak, roast veal, boiled veal, rabbit, salmon, mackerel, herring, pilchard, sprat, hard-boiled and fried eggs, pigeon, hare, duck, goose, fried fish, roast and boiled pork, heart, liver, kidneys, lobster, salted fish, crab."

The Necessity for a Mixed Diet. — *It is conceded by the best authorities that a mixed diet is an absolute necessity for man.*

While there is no doubt that a large number of persons suffer from an excess of animal food, observation proves that people who live upon a strictly vegetable diet "if required to exert themselves in any unusual way when food is deficient, they simply die. The reason is evident — they have been living upon their own tissues, and the small quantity of albuminous matter in grain is a long time in building them up again, so that for weeks

or even months their muscles are in a state of atrophy." (Chambers.)

The Chinese and Japanese are often cited as proof to the contrary, but in both instances, while living principally upon rice, their diet is supplemented by eggs, fish, pork, and chicken.

Thompson[1] writes: "Attempts have from time to time been made for economic reasons to furnish large bodies of laboring men with a purely vegetable diet; but this diet is found to defeat its own ends, in that the maximum of labor cannot be maintained by men who are fed exclusively on vegetable food, although some carbohydrates are necessary. It gradually induces a condition of muscular weakness and languor with disinclination for either physical or mental work. . . . And on the other hand, "A man cannot perform more actual muscular labor upon an exclusive diet of animal food than of starchy food. He requires abundant animal food to replace the general wear and tear of muscular tissue, but the energy for muscular contraction is not derived from nitrogenous food, but from carbohydrates, the former being used to keep the muscles in a healthful state of equilibrium. He who is physically feeble and who lacks muscular power cannot restore that power by an exclusive nitrogenous diet. A man fed upon nitrogenous diet without vegetable food may not work as well in daily labor as when given a fair proportion of the latter; but on the other hand he is better fitted for sudden arduous exertion than are exclusive vegetable feeders.

"A mixed diet therefore is the only rational one for man."

[1] *Practical Dietetics*, Thompson.

Section II

Varieties of Food. *Animal foods.* — The flesh of the herbivorous animals, domestic and wild fowls, eggs, fish, and milk and its products are the sources from which men derive animal food. Except fish, the flesh of carnivorous animals is unpalatable, although in time of need the flesh of horses and dogs and even cats is consumed.

In France and Germany the flesh of horses and dogs may be seen in many markets because of the high prices of other meats.

During the siege of Paris in the Franco-Prussian war it is said that a thousand dogs and five thousand cats were eaten after the food supply became nearly exhausted.

The nutritive value of meat is due to the presence of the proteids, fats, and mineral salts, the carbohydrates existing only in very insignificant quantities. All meat contains some fat, the greater the amount the larger its nutritive value. Pork usually contains a much greater proportion of fat than beef, while veal and fowls have comparatively little.

The flesh of young animals is more tender and therefore more easily digested. Raw meat is more easily digested than cooked meat.

Meat which has been properly roasted or broiled is more easily digested than when boiled or fried. Except in individual cases beef is the easiest of digestion and pork the most difficult, owing to its large proportion of fat.

With veal its digestibility varies greatly with the individual, some persons digesting it easily and others with the greatest difficulty. The white meat of fowls is more digestible than the dark. Ducks and geese are more

difficult to digest than other fowls, while wild fowls are more easily digested than domestic. Sweetbreads are easily digested, while liver, kidneys, and heart cannot be digested by persons with faulty digestion. The red meats (beef, mutton, and venison) are often prohibited to rheumatic patients, and less often for those suffering from disorders of the stomach or kidneys or from nervous troubles, the white meats (veal, chicken, and young pig) and fish only being allowed; it being supposed that the red meats contain a larger amount of nitrogenous substance and are irritating to the kidneys.

Diseased Meat. — Egbert[1] states that the following meats should not be eaten: "1. The flesh of all animals dead of internal diseases, or which have been killed while suffering from such diseases, or animals killed by overdriving. 2. The flesh of animals with contagious diseases that may be transmitted to man. 3. The flesh of animals that have been poisoned. 4. The flesh of animals with severe infectious diseases, as pyæmia, etc. 5. Flesh that contains parasites that may be transmitted to man. 6. All putrid flesh."

The diseases common in cattle which render them unfit for food are tuberculosis, pleuro-pneumonia, foot-and-mouth disease, anthrax, Texas cattle fever, and actinomycosis. In pigs the diseases are hog-cholera, tuberculosis, Trichina spiralis, anthrax, muco-enteritis, measles, and Cysticercus cellulosa.

Meat Inspection. — The inspection of meat differs greatly in different countries. In the United States the inspection is mostly under the Federal authorities, much of it being done in Chicago and Omaha, the great meat

[1] *Hygiene and Sanitation,* Egbert.

markets of the world. This, however, does not cover the quantities of meat consumed in the small towns and villages where the supply is local, and there can be no doubt but large amounts of diseased meats are eaten daily in all parts of the country. The inspection of meat is made both before and after the slaughtering of the animal, and includes observations upon the amount and condition of the fat, the consistency, color, and odor of the muscles, the condition of the bone marrow, lungs, kidneys, liver, spleen, and lymphatic glands.

The internal organs are examined for tumors, parasites, or suppuration, and the microscopical examinations are made principally for the detection of parasites such as trichina.

Evidences of tuberculosis are found in the lungs, pleura, or some of the lymphatic glands.

In the United States, as well as in most foreign countries, the meat of tuberculous animals is sold without any declaration as to its nature as wholesome meat when the disease is localized.

Thorough cooking will destroy any parasites or disease germs contained in diseased meat.

Meat and Fish Poisoning. — Some of the putrefactive changes in meat and fish produce toxins (poisons) and ptomaines (poisons produced by bacteria) which cause the cases of meat and fish poisoning in man. These cases arise more frequently from canned meats and fish than from fresh food. Unlike the parasites these toxins are not destroyed by cooking. Harrington cites the case recorded by Panum, "who found that the poison of certain putrid meat retained its activity even after it had been boiled 11 hours." It is found that it is not the ex-

tent of the putrefaction which determines the gravity of the poison, but the nature of the bacteria which have caused the change in the meat; some of the most violent cases of poisoning are recorded when the meat showed neither by look nor odor that putrefaction had begun, and on the other hand some meats in the advanced stage of decay were found harmless.

Transmission of Diseases by Meat and Fish. — Harrington[1] says that, "Concerning the possibility of transmission of tuberculosis by eating diseased meat there is practically no evidence of value, but whatever danger there is, if any at all, is disposed of by thorough cooking, since thereby the bacillus is quickly killed.

Three different kinds of tapeworm have been found to have been taken by man with imperfectly cooked meat and fish.

The disease due to *Trichina spiralis*, which is found only in pork, occurs very commonly in Germany, where the practice of eating meats which have only been smoked or not cooked at all, is more frequent than in America.

Fatal infections through abrasions of the skin are not uncommon among those who handle the flesh of cattle dead from anthrax and some other diseases.

Numerous epidemics and individual cases of typhoid fever have been traced to oysters taken from water which had been contaminated with sewage.

Milk. — Milk is one of the most important foods, as it contains all of the essential elements which go to make a complete food.

However, milk is such a good culture-medium that

[1] *Practical Hygiene*, Harrington.

it is invaded by bacteria of all kinds, and speedily becomes a source of danger unless handled with the greatest care.

The bacteria found in milk may come from a diseased cow, an unclean cow in unclean surroundings, filthy methods of milking, or dirty utensils, or impure water.

To obtain pure milk it is therefore essential that the cow should be clean and healthy, the milker of cleanly habits, and all utensils kept perfectly clean.

The thickening or souring of milk is due to certain bacteria which produce lactic acid; while other bacteria cause the milk to decompose before it sours. If bacteria were not present, milk would remain sweet indefinitely.

The bacteria of disease such as tuberculosis may come from the cow or have been conveyed to the milk.

The transmission of tuberculosis to man by means of infected milk is still open to some doubt, but there seems to be enough evidence to warrant the prohibition of selling milk from tuberculous cows.

Cows often have a condition known as *garget*, an inflammation of the udder; milk from a cow thus afflicted causes intestinal disorders in infants and young children.

The most common diseases conveyed by milk are not, however, derived from the cow, but are due to the lack of cleanliness, or to bacteria conveyed to the milk by flies or other insects, or by vermin, or by the use of polluted water. These diseases are typhoid fever, diphtheria, scarlet fever, and cholera.

Numerous epidemics have been traced directly to

the dairyman or some other dealers who have handled the milk before it reached the consumer.

Cases of milk poisoning, many of them fatal, are due to the presence of certain bacteria which are found in unclean milk, or milk cans, or ice-cream freezers.

The most important disease produced in this way is "cholera infantum, so common among infants who feed upon cow's milk in warm weather. It is easy to understand the nature of this disease when we remember the great number of bacteria in milk, especially in hot weather, and when we remember that the delicate organism of the infant will be thrown at once into disorder by slight amounts of poison which would have no appreciable effect upon the stronger adult. We can easily understand, further, how the disease readily yields to treatment if care is taken to sterilize the milk given to the patient." (Professor Conn.)

Any utensils used for storing milk should not be used for other purposes; they should be rinsed in cold water, scrubbed vigorously in hot soapsuds, scalded in clear, boiling water, wiped with clean, dry towels, and be kept standing upside down.

The use of preservatives in milk, such as salicylic acid, boracic acid, and formaldehyde, is forbidden by the laws of many states and cities, as they are detrimental to health.

The regulations regarding milk have greatly improved in cities in recent years, but much more needs to be done, especially in the country.

Cream is the fat of milk which rises to the surface upon cooling, and after separation from the milk is turned to butter by agitation.

Cream is a most agreeable and wholesome form of fat. It is sometimes substituted for cod-liver oil for tuberculous patients, and is an important article of diet, when it is borne well, for the long-continued wasting diseases. The addition of limewater will often render cream more digestible.

Cheese is one of the products of milk which has been used for ages as an important article of food. It is made from the curds of cows' or goats' milk, and may be made from skimmed milk, the whole milk, or by the use of whole milk and cream. Cheese, like veal, may be easily digested by some individuals, and be highly indigestible to others.

Cheese poisoning is not unknown, caused by the action of certain bacteria which also invade milk, cream, and butter.

Fish as an article of diet vary in nutritive value and digestibility; eels, herring, and salmon contain the largest amount of fat, and consequently are the most nutritious, but are much less digestible than sole, flounders, or whiting. Pavy says that, "the whiting is the most delicate, tender, and easy of digestion of all fish."

Salted fish are less easy to digest than fresh fish.

Fish should always be eaten when perfectly fresh, the best test of freshness being the bright redness of the gills and the fullness of the eye.

Fish is often allowed to patients with Bright's disease and other disorders, when meat is forbidden.

The poison arising from decomposing fish is more violent and more often fatal than similar cases of meat poisoning.

There are some individuals who cannot eat fish of any kind without symptoms of poisoning, and others who must avoid only certain kinds, like shellfish which produce skin disorders such as *urticaria* (hives).

Lobsters, crabs, clams, shrimps, and oysters afford a wholesome diet when perfectly fresh.

Section III

The Vegetable Foods. — The cereals, wheat, rye, barley, oats, corn, and rice, are among the most important foods; all contain some proteids, a large proportion of carbohydrates, some fat, and phosphates.

Wheat contains the largest percentage of proteid material, and rice the least.

The large percentage of protein contained in the legumes — peas and beans — renders them a valuable source of nitrogenous food as they are both inexpensive.

The grinding breaks up the grain and starch granules, separates the indigestible parts, and renders the starch suitable for cooking.

Composition of the Cereals[1]

Cereal	No. of analyses	Nitrogenous substances	Fat	Nitrogen-free extractives	Cellulose	Ash	Nitrogen
		Per ct.	Per ct.	Per ct.	Per ct.	Per ct.	Per ct.
Wheat	1358	13.89	2.20	79.75	2.19	1.97	2.22
Rye, winter	173	12.48	1.77	81.04	1.78	2.06	2.00
Barley	766	11.24	1.93	77.24	4.95	2.42	1.79
Oats	377	12.13	4.99	66.41	10.58	3.29	1.94
Corn, flint	80	11.74	4.78	79.20	1.67	1.40	1.88
Rice	10	7.00	2.00	84.76	4.00	1.16	1.12

[1] *Principles of Hygiene*, Bergey.

Composition of the Leguminosæ

	No. of analyses	Nitrogenous substances	Fat	Nitrogen-free extractives	Cellulose	Ash	Nitrogen
		Per ct.	Per ct.	Per ct.	Per ct.	Per ct.	Per ct.
Beans	63	29.26	1.68	55.86	8.06	3.13	4.68
Peas	72	26.39	1.39	61.20	5.68	2.68	4.30

Flour ground by the old process is softer and smoother than by the new roller-process.

Wheat flour should not be too white, as that shows a lack of gluten. "Good flour holds together in a mass when squeezed by the hand, and retains the impressions of the fingers, and even the marks of the skin much longer than poor flour; when made into a dough, it is elastic, easy to be kneaded, will stay in a round, puffy shape, and will take up a large amount of water,[1] while poor flour will be sticky, flatten or spread itself over the board, and will never seem stiff enough to be handled, no matter how much flour is used."[2]

Flour of any kind should be kept in a dry place.

Besides white flour, Graham flour and entire wheat flour are made from wheat. Graham flour contains the entire grain, even the outside husk, while entire wheat flour contains all but the husk.

"Parenthetically, it may not be out of place to refer here to the absurd views maintained by a large part of the community as to the superiority from a hygienic standpoint of foods containing all of the constituents of the cereals from which they are prepared. It is difficult to understand how the nutritive value of any food can

[1] One third of its bulk is the rule for bread.

[2] *Boston Cook Book*. Mrs. Lincoln.

be increased by the retention of matters which are completely indigestible, and to a certain extent irritating to the digestive tract. It is argued that an all-wise Creator made wheat, for example, in the form in which we see it, and that it is not for us to attempt to improve it as we think by discarding the outer layers. But this sort of reasoning might be extended so as to favor the consumption of the peel of oranges, the bones of fish, the

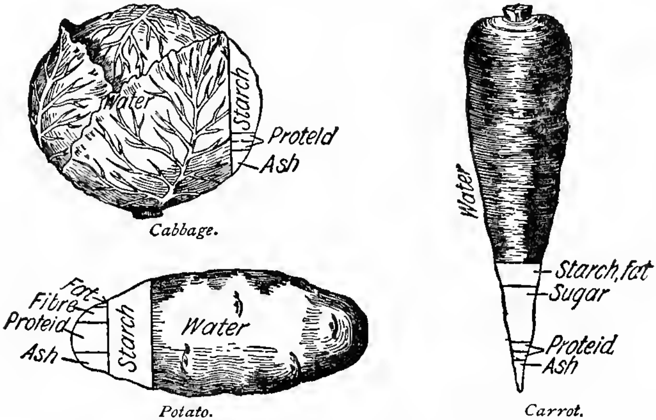


FIG. 13. — The composition of three common vegetables.

feathers of birds, and other innutritious and undesirable waste products."[1]

Bread. — Bread is one of the most important forms of food, and is the most generally used food known. Wheat, being the most nutritious cereal and containing gluten, is the best adapted to bread making.

Bread contains flour, water, and salt, although its flavor and nutritive value are improved by the addition

[1] *Practical Hygiene*, Harrington.

of sugar, milk, and butter. Well-made bread containing a small amount of fat is nearly a complete food in itself, hence the name "the staff of life."

To render bread "light" and digestible yeast is added to the other ingredients, the whole being kept in a temperature about 70° F. for several hours. The yeast acts upon the sugar and converts it into alcohol and carbonic acid gas, the latter by its expansion causing the bread to become porous and "rise."

If this process of fermentation is incomplete, the bread is heavy, and if continued too long, the bread "sours" from the formation of lactic and acetic acids.

Good bread should be white, sweet, and spongy, with a tender crust.

Bread is more easily digested after twenty-four hours old.

Bread may acquire unwholesome properties by improper care. It should be removed from the tins and cooled upon a rack that the air may circulate upon all sides of the loaves. It should be kept in a closely covered earthen jar which should be used for no other purpose, and be washed and scalded between each baking. Damp, moldy bread may cause serious digestive disturbances.

Baking Powders. — In lieu of yeast, a variety of baking powders are used to "leaven" different kinds of bread, rolls, biscuit, griddle cakes, cookies, and other sweet cakes.

Many cooks make their own baking powder by using 1 part of bicarbonate of soda and 2 parts of cream-of-tartar, this combination being the basis of the so-called "cream-of-tartar" baking powders.

The action of potassium acid tartrate (cream of tartar) upon sodium bicarbonate liberates carbonic acid gas (carbon dioxide).

The combination of bicarbonate of soda with sour milk is a common and wholesome "leaven," provided the soda is not used in excess, and is thoroughly sifted and blended with the dry ingredients before the sour milk is added, the amount used being governed by the degree of sourness of the milk.

The phosphatic baking powders are equally good and wholesome, and are much less expensive. Baking powders containing alum are universally condemned as injurious to health.

The vegetables afford little proteids and fats, but a large proportion of carbohydrates and the mineral salts, and give variety to our diet.

Vegetables may be divided into tubers, such as potatoes, sweet potatoes, and Jerusalem artichokes, all of which yield a large proportion of carbohydrates; the roots, as carrots, radishes, beets, turnips, parsnips, which yield little nutriment and are chiefly valuable for their antiscorbutic (remedy or preventive of scurvy) properties.

The herbaceous vegetables, such as lettuce, cabbage, celery, asparagus, onions, spinach, and leeks, are also chiefly important on account of their mineral salts and of the variety they afford.

The tomato, cucumber, squash, pumpkin, and eggplant are really fruits used as vegetables; they contain about 90 per cent of water and are very poor in proteids, and contain about 8 or 9 per cent of carbohydrates.

In the use of uncooked vegetables, such as lettuce, radishes, young onions, and celery, great care should be

taken in cleaning them properly. The germs of infectious diseases, such as typhoid fever, are found in the various fertilizers used upon the soil, and vegetables washed in polluted water may also be a source of infection.

The farinaceous (prepared starch) **foods** are arrowroot, tapioca, cooked chestnuts, and sago, all easily digested and much used in diet for the sick.

Vegetable fats are derived from nuts, olives, and cotton seed.

Olive oil is the most valuable as well as palatable vegetable oil used for food. Pure olive oil is of a greenish yellow color. The adulteration of olive oil with cotton-seed oil has been very common.

Nuts are very nutritious on account of their large proportion of fat, but are difficult to digest. The nuts most commonly used in the United States are peanuts, walnuts, hickory nuts, cocoanuts, almonds, and chestnuts. Peanuts contain less fat and more protein than any of the others. In Italy, France, and Spain, chestnuts are used in many cooked forms, very largely in bread, or simply roasted.

Fruits. — By fruits we generally understand the products which are sufficiently palatable to be used raw as desserts. They are chiefly valuable for their mineral salts.

Eaten when ripe, and in moderation, they are wholesome and easily digested; unripe or decayed fruit produces digestive disturbances of more or less violent character.

It is considered better to eat fruit early in the day, as at breakfast. Fresh fruit is better than dried or pre-

served fruit, but fruit in some form should form a part of the diet throughout the year.

Bananas and figs are the most nutritious fruits, both being staple articles of food in the countries where they grow.

Of the large number of berries used in the United States, cranberries and gooseberries are the only varieties which need cooking and the addition of sugar to render them palatable.

Some persons are unable to eat strawberries, either by reason of the intestinal disturbance produced, or because of *urticaria* resulting.

Sugar for food is obtained from sugar cane, glucose from corn, dextrose or grape sugar and beet sugar; beet sugar being much used in Europe.

Maple sugar, made by boiling the sap of the maple tree, is probably made only in the United States, where it is used as molasses or as a confection rather than for general purposes.

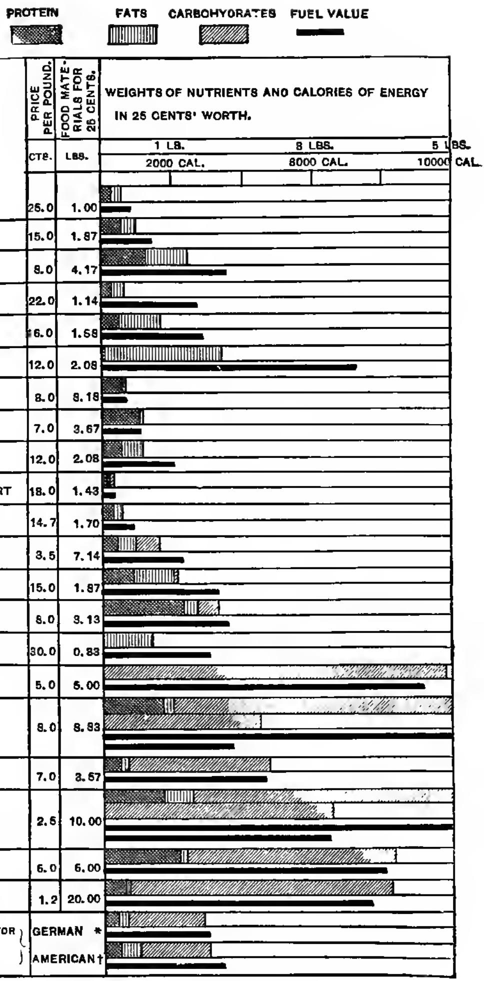
Honey, which contains about 73 per cent of sugar, may be regarded as a vegetable product.

Mineral Food. — The mineral most important as an element of food is salt (chloride of sodium). It stimulates the flow of gastric juice, thus promoting digestion.

Vegetables are deficient in salts, and the addition of sodium chloride while cooking renders them more palatable and digestible. The phosphates, sulphates, and other salts of sodium, potassium, and magnesium are present in sufficient quantities in a mixed diet.

Beverages. — Besides water, the important non-alcoholic beverages are tea, coffee, milk, cocoa, chocolate, and the various carbonated drinks made by charging

		PRICE PER POUND.	FOOD MATERIALS FOR 25 CENTS.
		CTS.	LBS.
ANIMAL FOODS	BEEF, SIRLOIN	25.0	1.00
	BEEF, ROUND	15.0	1.67
	BEEF, NECK	6.0	4.17
	MUTTON, LEG	22.0	1.14
	HAM, SMOKED	16.0	1.56
	SALT PORK, VERY FAT	12.0	2.08
	CODFISH, FRESH	8.0	3.13
	CODFISH, SALT	7.0	3.57
	MACKEREL, SALT	12.0	2.08
	OYSTERS, 35 CTS. QUART	18.0	1.43
	EGGS, 25 CENTS DOZEN	14.7	1.70
	MILK, 7 CENTS QUART	3.5	7.14
	CHEESE, WHOLE MILK	15.0	1.67
	CHEESE, SKIM MILK	8.0	3.13
	BUTTER	30.0	0.83
VEGETABLE FOODS	SUGAR	5.0	5.00
	WHEAT FLOUR	3.0	8.33
	WHEAT BREAD	7.0	3.57
	CORN MEAL	2.5	10.00
	BEANS	5.0	5.00
	POTATOES	1.2	20.00
	STANDARD FOR DAILY DIET FOR MAN AT MODERATE WORK	GERMAN *	
		AMERICAN †	



* VOIT † ATWATER

FIG. 14. — A table of food values.

a mixture of fruit sirup, flavoring, and water with carbonic acid gas.

Of the various mineral waters there are alkaline and sulphur, besides the various purgative waters.

Tea, coffee, and cocoa have a mildly stimulating effect, producing what Egbert describes as a "sense of comfort." Used to excess they produce insomnia, indigestion, nervous irritability, and palpitation of the heart. Tea and coffee are not nutritious in themselves, but are made slightly so by the addition of cream and sugar.

Cocoa and chocolate contain a considerable amount of nutrition, but by some persons are not easily digested, especially chocolate.

"But these beverages may all be abused in their use as readily as may alcohol, and 'tea-drunkards' and 'coffee-drunkards' are not uncommon. The teacup is not always the one that 'cheers but does not inebriate.' Women especially who drink much tea are apt to be nervous and dyspeptic, to have the 'tea-drinker's heart,' and to suffer from headaches and neuralgias. They depend upon tea to take the place of nutriment, and soon use up what little store of force they may have had, since they fail to replenish it with fuel-food. Men are more addicted to the use and abuse of coffee, and often manifest symptoms directly traceable to such intemperance." (Egbert.)

Alcoholic beverages differ greatly in the amount of alcohol contained, from beer containing from 3 to 5 per cent, to brandy and whisky containing from 40 to 47 per cent of alcohol.

The objection to the use of alcoholic beverages is the fact that their constant use tends to the acquirement of

the drink habit, and leads to grave derangement of health, of both body and mind, and for these reasons the use of alcoholic beverages is to be strongly condemned.

The habit of using alcoholic beverages to excess is commonly supposed to be the cause of poverty, while in reality the best authorities declare that poverty is almost exclusively the cause of drink.

Liebig, who was considered one of the greatest scientists upon the chemistry of food, writes that "the use of spirits is not the cause but the effect of poverty. It is the exception to the rule when the well-fed man becomes a spirit-drinker. On the other hand, when the laborer earns by his work less than is required to provide the amount of food which is indispensable in order to restore fully his working power, an unyielding, inexorable law or necessity compels him to have recourse to spirits. He must work; but in consequence of insufficient food a certain portion of his working power is daily wasting. Spirits, by their action on the nerves, enable him to make up the deficient power at the expense of his body; to consume to-day that quantity which naturally ought to have been employed a day later." And to this Egbert adds, "This may also be the case where there is an abundance of food, but where it is improperly chosen for the needs of the individual or ruined by bad cooking. Education in the principles of the scientific and economical selection of food and its preparation may thus become a means of preventing those diseases that depend on or are aggravated by insufficient or improper food and consequent alcoholic excesses. The effect of alcohol upon the weak and savage races is much more marked and disastrous than upon the

civilized and strong; so it harms the health of the underfed and overworked much more than it does that of the well-fed man of means and leisure, and affects women and children more than adult men."

Condiments include a large number of substances of no nutritive value in themselves, but used as flavoring. They enhance the value of other foods by rendering them more palatable.

Of the simple substances, the common are salt, pepper, vinegar, mustard, cloves, cinnamon, nutmeg, allspice (pimento), mace, lemon and orange juice and peel, and sage, besides an innumerable list of catsups, curries, and sauces compounded from a combination of many spices, with vinegar and fruit or vegetables.

The tendency in hot countries is toward the excessive use of "hot" spices and high seasoning which in time impairs digestion.

Section IV

COOKING OF FOOD

While it is possible for man to live for some time upon raw foods, yet it seems that Nature intended him to make use of the fruits of the earth which are adapted to his use only by the process of cooking. The most primitive savage races practice cooking in rude forms, and it is observable that the higher a race stands in civilization the more advanced its fashion of cooking becomes.

Doubtless at one time men lived entirely upon raw food, and the Eskimo still prefers his meat raw and frozen.

As a rule all animal food except milk, eggs, and bivalves

require cooking to be acceptable to our modern tastes, while most fruits and a few vegetables are eaten raw by preference.

Cooking develops the flavor of foods, meat particularly; it alters the consistency, most food except eggs and oysters being made softer and more easily masticated. Cooking renders many foods more easily digested; this being particularly true of meats and starchy foods. Cooking destroys many germs and parasites which might be injurious, and cooking improves the appearance of many foods, rendering them more appetizing in consequence.

Varieties of Cooking. — There are seven common ways of cooking in use: boiling, stewing, baking or roasting, broiling, frying, braising, and steaming; and by these means we secure a variety which is a valuable stimulant to the appetite. A monotonous diet speedily becomes unappetizing and lessens the power of digestion.

Boiling food is really an incorrect expression, as the water boils, not the meat or vegetable.

It should always be borne in mind that water at the boiling point (212° F.) cannot be made any hotter in an ordinary cooking utensil, and that furious boiling is a waste of fuel.

When meat, for instance, is to be cooked by boiling, it should be first immersed in water boiling hard for five minutes and then be put where the water may be kept just below the boiling point for several hours; in this way the albumin in the outer coat will be cooked by the first hard boiling, thereby confining the juices of the meat, and the slow cooking at the lower temperature prevents the fiber from becoming tough and stringy. Meat should

never be pierced with a fork while turning it in the boiling water, which allows the escape of juice.

If broth or soup is desired, the meat should be cut in small pieces, put into cold water, and gradually brought up to near the boiling point; in this way the juices of the meat are extracted, but the richness of the broth will depend largely upon the management of the heat.

Salt added to the water raises the boiling point of the water to 224° F., and by the increase of the density of the water the juices of the meat are better retained and its flavor improved. Hence in making broth the salt should be added at the end of the cooking, while in cooking meat or vegetables the salt should be added first.

Stewing is a process whereby the juices of the meat are partly retained. The meat is put on in cold water and quickly brought to the boiling point, when it is allowed to simmer slowly for two or three hours.

Roasting or Baking. — Roasting, meaning to "heat violently," was formerly employed with open fireplaces where 1000° of heat might be obtained, but roasting in the oven or baking is now used instead. In roasting, the sudden high temperature produces a firm coagulation upon the surface which retains all of the juices and renders the meat far more palatable and nutritious than when boiled.

After the surface is well cooked the heat should be reduced to prevent charring, and the meat be frequently "basted" to prevent the escape of steam by evaporation, so that the inside of the meat is really cooked in the steam of its own juices. The smaller the roast the more frequently it should be "basted."

Broiling, meaning to "burn," is cooking directly over

the hot coals or under a gas flame; in either case the broiler should almost touch the coals or gas flame. The degree of heat is so great that the articles to be cooked would burn very quickly if they were not frequently turned. The secret of good broiling is in the frequent turning. Broiling is employed for meat, fish, fowls, and oysters. Meat should be broiled only long enough to loosen the fibers and start the flow of juices. If broiled too long, the juices ooze through the fiber and are evaporated, and the meat becomes dry, leathery, and indigestible.

Frying is cooking by immersion in hot fat; not boiling fat which is about 565° F., but smoking hot fat which is 385° F. The fat should be deep enough to completely cover the articles, and when at the right temperature, the food is at once encased by the instant cooking of the albumin which prevents the absorption of any more fat and is very quickly cooked. The food should be dry and warm before immersion, otherwise the fat is quickly cooled and the food absorbs it, making it heavy, greasy, unpalatable, and very indigestible.

The test for the heat of fat may be done by dropping a bit of bread into it; if it browns while counting sixty as the clock ticks, it is hot enough for potatoes or doughnuts, and while counting forty, for fish balls, croquettes, etc.

Properly done, fried food is both palatable and digestible.

Braising. — Braising is a form of stewing done in a closely covered pan or kettle in the oven. It is an economical way of cooking large pieces of tough lean meat, liver, fowls, heart, etc.

Steaming is a process of cooking over boiling water either by a perforated steamer placed directly over a vessel of boiling water or by a double boiler. Watery vegetables are better steamed than boiled; tough pieces of meat may be first steamed and then browned in the oven; and milk and all kinds of grains which are liable to adhere to the kettle are best cooked in a double boiler.

Cooking of Fish. — Fish may be cooked by boiling, stewing, broiling, baking, or frying.

Fish which has been boiled is more easily digested than by any other method of cooking, and broiled fish is next in order. Fish should be boiled in salted water to preserve its flavor and shape.

Fish requires much less time for cooking than meat.

Cooking of Vegetables. — Green vegetables should be freshly gathered, washed in cold water, and cooked in freshly boiling salted water. Wilted vegetables require much longer cooking than fresh.

All vegetables should be cooked until soft and tender, and no longer.

All vegetables require the addition of butter or some form of fat as well as salt to render them palatable. Peas, beans, squashes, beets, and turnips need the addition of a small amount of sweetening, as much of their natural sweetness is lost in cooking, while those containing potash salts, such as lettuce and cabbage, need an acid condiment.

Vegetables which are eaten raw are usually dressed with some condiment: oil, vinegar, pepper, and salt.

The cereals such as oatmeal, corn meal, barley, and wheat preparations need long, slow steaming to be either palatable or digestible. The lumpy, sticky, half-

cooked porridge or mush which is so commonly served is unpalatable and highly indigestible, particularly for children.

It is impossible in a book of this character to go into further details in the cooking of food, although thorough instruction upon the subject is sadly needed, for as a people we suffer less from food which was bad when it came to our hands than we do from our ignorance of cooking and our wasteful methods.

Section V

Food Preservation and Adulteration. — By the preservation of food we understand a process whereby food may be kept for a certain length of time or indefinitely without putrefaction.

Since putrefaction is due to bacteria present in the atmosphere, it is necessary for the preservation of food to protect it in some way from these germs. Heat and moisture being favorable to the growth of bacteria, certain foods such as meats, milk, berries, tomatoes, and others containing much moisture rapidly decompose in hot weather.

There are four common methods of preserving food: —

1. Drying.
2. Exclusion of air (with and without heating).
3. Exposure to cold.
4. Treatment with chemical agents.

Drying. — Drying is a process more suitable for certain fruits and vegetables than for meat, as meat when dried becomes tough, unpalatable, and loses much of its digestibility.

Fish which have been previously salted lose less of their flavor and digestibility than meat.

Eggs and milk are also dried.

Drying may be accomplished by the sun or by artificial means. Drying in the sun is easily done in a dry, sunny climate, but is difficult near the sea or large bodies of water.

Raisins, figs, and prunes are usually sun-dried, as Spain and California, where most of them grow, have both hot, dry climates; but in the more temperate climates, where large quantities of apples and peaches are dried for the market, artificial heat is employed, the fruit being usually called "evaporated" fruit.

The efficiency of the drying process depends upon the thoroughness with which it is done, and drying does not prevent the invasion of parasites.

Exclusion of air is accomplished in various ways: by immersing the food in oil or fat, as sardines; by coating with some impervious substance such as paraffin or varnish; or covering with dry salt or sawdust, as with eggs.

Meat and fish are frequently preserved by exposing them for many days to the smoke from wood ashes which coagulates the outer surface, rendering it impermeable, and at the same time gives the food a peculiar flavor very palatable to most people. Meats and fish are usually put into a salt brine for some days before smoking.

Food is canned by packing it tightly in tin cans which are sealed except a pin hole, and then steamed for several hours until thoroughly cooked and sterilized, when the pin hole is soldered. This is the process used for

canning meats, fruit, and vegetables for the markets, and when perfectly fresh food is used under cleanly methods, the food is wholesome.

The danger from canned goods may be from the action of the tin and solder upon meats or acid fruits and vegetables ; or from food which was not fresh nor clean, or from lack of cooking or defects in sealing.

All canned foods should be removed from the tins immediately when the can is opened, but this is unnecessary when glass cans are used.

Exposure to cold is effected either by freezing, or by putting the food into a refrigerating chamber with a temperature two or three degrees above the freezing point. Frozen food will keep indefinitely, but loses much of its flavor. By the use of refrigeration or "cold storage," as it is commonly known, fresh meat is transported from the United States, from New Zealand and South America to England and the Continent.

Properly done, meat and other foods are often kept perfectly for several months, but there is room for many technical flaws in the process, and unless properly inspected, much dangerous food may be thrown upon the market.

Chemical Preservation. — Salt and sugar are the oldest and least harmful of all chemical preservatives. It is said that the process of brine-salting fish is the oldest method of food preservation known. Both meat and fish lose some of their nutritive value and become less digestible when salted.

A long-continued diet of salt meat or fish is conducive to scurvy.

Sugar in a concentrated sirup is used to preserve

fruits, and dry sugar is used with dried fruits. Vinegar acts as a preservative in pickling vegetables, fruits, and oysters.

The use of such antiseptics as boracic acid, salicylic acid, and formaldehyde in small quantities and as an occasional ingredient of a diet has not been found harmful, but their continued use cannot fail to be injurious to health. Laws have been enacted in many states to regulate the use of these antiseptics, particularly in milk and beer.

The adulteration of food in this and other countries reached an enormous extent before the passage of the Pure Food and Drugs Act by Congress, which went into effect January 1, 1907.

On January 1, 1908, one year after the law went into effect, Dr. Wiley, Chief of the Bureau of Chemistry, of the Department of Agriculture, reported that 95 per cent of all the manufacturers and dealers in foods, drugs, and beverages are now supplying pure articles, correctly labeled. According to the laws of many of the states a food is declared to be adulterated under the following conditions: —

" ' First, if any substance or substances have been mixed with it, so as to lower or depreciate or injuriously affect its quality, strength, or purity; second, if any inferior or cheaper substance or substances have been substituted wholly or in part for it; third, if any valuable or necessary constituent or ingredient has been wholly or in part abstracted from it; fourth, if it is an imitation of or is sold under the name of another article; fifth, if it consists wholly or in part of a diseased, decomposed, putrid, infected, tainted, or rotten animal or vegetable

substance or article, whether manufactured or not, or, in the case of milk, if it is the product of a diseased animal; sixth, if it is colored, coated, polished, or powdered, whereby damage or inferiority is concealed, or if by any means it is made to appear better or of greater value than it really is; seventh, if it contains any added substance or ingredient which is poisonous or injurious to health: *Provided,* That the provisions of this act shall not apply to mixtures or compounds recognized as ordinary articles or ingredients of articles of food, if each and every package sold or offered for sale bear the name and address of the manufacturer and be distinctly labeled under its own distinctive name and in a manner so as to plainly and correctly show that it is a mixture or compound, and is not in violation with definitions fourth and seventh of this section.'

"The claim is made by some manufacturers that the addition of a preservative to food does not properly constitute adulteration because the preservatives added are of greater commercial value than the foods themselves. Such a claim, however, seems to be nothing but a play upon words. For instance, benzoate of soda has a greater commercial value, weight for weight, than tomatoes, and the claim has been made that for that reason its addition to tomatoes actually increases the expense of the preparation of tomato catsup. As a matter of fact, however, it permits the tomato pulp to be prepared in large quantities and preserved in barrels in a much less expensive way than can be done without its use. It is evident, therefore, that even though the preservative employed is more expensive than the substance to which it is added, the addition is really made

for the purpose of cheapening the product. It is not for this reason that such a substance is properly called an adulterant, however, but because it is an added foreign substance and is neither a food nor a condiment. These definitions cannot be emphasized too strongly. Adulterated foods are not necessarily unwholesome foods.

"The term 'misbranded' is appropriately applied to foods incorrectly described by the label. The word has not the same significance as 'adulterated,' and yet the two terms may frequently be applied to the same product. For instance, commercial starch is sometimes added to sausage to increase its weight and permit of the use of a larger amount of water or of fatter meat than could otherwise be used. Such a product may properly be deemed adulterated, and at the same time, if the article were properly branded, it might not be open to objection either on the score of unwholesomeness or adulteration. If such an article, however, be sold simply as sausage, the purchaser must naturally assume that no substance has been added to increase the weight of the material without a corresponding increase of nutritive value. The addition of starch to sausage, therefore, is not in itself deleterious to health, but in the absence of a proper declaration is a fraud, because it cheapens the article which the customer supposes he is buying. In this connection, however, attention should be called to the claim of packers that 1 or 2 per cent of starch should be added to the sausage that is to be boiled, in order to prevent its shrinking when the sausage is cooked.

"The following definitions of 'adulteration' and

'misbranding,' as applied to foods, are taken from the food bill now pending in Congress:[1]

"'Sec. 6. That for the purposes of this act an article shall be deemed to be adulterated —

"'In the case of food:

"'First. If any substance has been mixed and packed with it so as to reduce or lower or injuriously affect its quality or strength.

"'Second. If any substance has been substituted wholly or in part for the article.

"'Third. If any valuable constituent of the article has been wholly or in part abstracted.

"'Fourth. If it be mixed, colored, powdered, coated, or stained in a manner whereby damage or inferiority is concealed.

"'Fifth. If it contain any added poisonous or other added deleterious ingredient which may render such article injurious to health: *Provided*, That when in the preparation of food products for shipment they are preserved by an external application applied in such manner that the preservative is necessarily removed mechanically, or by maceration in water, or otherwise, the provisions of this act shall be construed as applying only when said products are ready for consumption.

"'Sixth. If it consist in whole or in part of a filthy, decomposed, or putrid animal or vegetable substance, or any portion of an animal unfit for food, whether manufactured or not, or if it is a product of a diseased animal, or one that has died otherwise than by slaughter.

"'Sec. 7. That the term "misbranded," as used

[1] House of Representatives, Fifty-ninth Congress, Report No. 2118, March 7, 1906.

herein, shall apply to all drugs, or articles of food, or articles which enter into the composition of food, the package or label of which shall bear any statement regarding the ingredients or substances contained in such article, which statement shall be false or misleading in any particular, and to any food or drug product which is falsely branded as to the State, Territory, or country in which it is manufactured or produced.

" 'That for the purposes of this act an article shall also be deemed to be misbranded:

" 'In the case of food —

" 'First. If it be an imitation of or offered for sale under the distinctive name of another article.

" 'Second. If it be labeled or branded so as to deceive or mislead the purchaser, or purport to be a foreign product when not so.

" 'Third. If, in package form, the quantity of the contents of the package be not plainly and correctly stated in terms of weight or measure, on the outside of the package.

" 'Fourth. If the package containing it or its label shall bear any statement, design, or device regarding the ingredients or the substances contained therein, which statement, design, or device shall be false or misleading in any particular: *Provided*, That an article of food which does not contain any added poisonous or deleterious ingredient shall not be deemed to be adulterated or misbranded in the following cases:

" 'First. In the case of mixtures or compounds which may be now or from time to time hereafter known as articles of food, under their own distinctive names, and not an imitation or offered for sale under the distinctive

name of another article, if the name be accompanied on the same label or brand with a statement of the place where said article has been manufactured or produced.

" 'Second. In the case of articles labeled, branded, or tagged so as to plainly indicate that they are compounds, imitations, or blends: *Provided*, That the term "blend" as used herein shall be construed to mean a mixture of like substances, not excluding harmless coloring or flavoring ingredients: *And provided further*, That nothing in this act shall be construed as requiring or compelling proprietors or manufacturers of proprietary foods which contain no unwholesome added ingredient to disclose their trade formulas, except in so far as the provisions of this act may require to secure freedom from adulteration or misbranding.' "

CHAPTER III

AIR, CLIMATE, VENTILATION, HEATING, LIGHTING

SECTION I

Nature and Composition of the Atmosphere. — Air consists of a mechanical mixture of gases, of remarkable uniformity, which envelops the earth to a depth which is estimated to be about forty miles, and which penetrates the soil and the ocean.

The weight pressure of the atmosphere, which is estimated by means of the barometer, is equivalent to about fourteen tons to the surface of an adult human body.

The pressure of the air decreases as we rise above the sea level, and increases as we descend below its level; and any considerable or sudden variation in this pressure may produce disturbances of health, such as the heart derangements common to persons first visiting high altitudes, known as "mountain or balloon sickness," and the "caisson disease" of tunnel workers or others laboring in compressed air.

A sudden increase or decrease of atmospheric pressure is especially injurious to all persons suffering from heart or lung diseases.

By an arrangement of air locks, workmen coming out of a caisson may do so safely by a wait of six or eight minutes at each lock. Too rapid change of pressure with great physical exertion may produce spinal hemorrhage.

Composition of Air. — Air is a transparent, colorless,

and odorless mixture of oxygen, nitrogen, argon, carbonic acid (carbon dioxide), and traces of other substances. Ordinarily air is not odorless, but contains scents arising from many sources to which we become accustomed and do not detect them.

The average normal composition of air is about as follows: oxygen, 21 per cent; nitrogen and argon, 78.7 per cent; carbon dioxide (carbonic acid), 0.03 per cent; aqueous vapor varying with the temperature and other conditions; a trace of ammonia; and a variable amount of ozone, organic and other matters.

The mixture of the air is mechanical, not chemical, as was formerly supposed, its wonderful uniformity being maintained by the relative processes of animal and vegetable life, and by the law governing the diffusion of gases, which is that "a gas expands into a space in which there is another gas, as freely and as rapidly as if there were a vacuum."

Oxygen is the element in the air which supports life. The normal amount of oxygen in the atmosphere may vary slightly, as at sea or near vegetation by day it may be slightly increased, or at a great altitude it may be a very little less; but at sea level any decrease in amount would be readily overcome by the law of diffusion.

Oxygen is constantly being taken up from the air by respiration, and returned to it in combination with carbon, known as carbon dioxide, which is in turn taken up by vegetation, the carbon being retained and the oxygen returned to the air, thus maintaining the uniformity of the atmosphere.

For sustaining animal life the air must contain not far from a normal amount of oxygen. Human life is

impossible with less than four fifths of the normal proportion, and equally so when greatly increased. The decrease of oxygen to less than 13 per cent causes respiration to become slower and more difficult, and asphyxia and death soon follow. Fatal asphyxia occurs very speedily when the volume of oxygen has decreased to 3 per cent.

It is stated that the lungs of an adult man absorb about one fourth of the oxygen inhaled, and that he inhales in 24 hours 34 pounds of air, containing something over 7 pounds of oxygen, which would mean that slightly less than 2 pounds of oxygen is absorbed daily.

Oxygen is also essential to the growth of vegetation, for while plants take up carbon dioxide and exhale oxygen, they also breathe as do animals by absorbing oxygen and exhaling carbon dioxide.

Nitrogen, the principal constituent of the atmosphere, serves to dilute the oxygen, rendering it respirable, but nitrogen takes no further part in animal respiration. Nitrogen is absorbed by certain plants (legumes) directly from the air and stored for animal use in the form of proteids, the original source of nitrogenous foods.

Argon is a recently (1894) discovered element of air, its quantity and purpose still being uncertain.

Ozone is a normal but inconstant element of air of unknown origin, which is almost never found in large cities, towns, or inhabited dwellings, but has been found in minute quantities (1:700,000) in the open country, or at sea.

Hydrogen, *krypton*, *neon*, and several other elements have been discovered in traces as constituents of air.

Carbon dioxide is found in all air, the normal average in pure air being 3 parts in 10,000, or 0.03 per cent. Carbon dioxide results from the oxidation of organic matter, from respiration, fermentation, combustion, and chemical action of the soil, and within the limit of 3 parts to 10,000 may not be considered an impurity of the atmosphere.

The respiration of millions of human beings and animals, the combustion of coal, wood, gas, and all other fuel, and the huge volumes sent forth by the air from the soil, throw tons of carbon dioxide into the atmosphere, which is purified of its excess by the absorption of it by vegetation and great bodies of water; the latter, it is said, will take up its own volume of the gas.

It is generally held that a large amount of carbon dioxide may be present in the air without producing any injurious effects, *provided* there is an abundance of oxygen; that the ill effects of impure air arise from the organic matter thrown off with the carbon dioxide from the skin and lungs.

A crowded assembly room may contain as high as 100 parts of carbon dioxide to 10,000.

The *aqueous vapor* in the atmosphere varies with the temperature, evaporation, and condensation going on continuously. The higher the temperature the more rapidly evaporation takes place. The proportion of humidity most agreeable and healthy for human beings is about 75 per cent of saturation at any given temperature.

The sources of aqueous vapor in the air are from bodies of water, moisture from the soil, from the skin and lungs of men and animals, from foliage, and from combustion.

Ammonia and organic matter, exceeding a trace, in outdoor air may be regarded as impurities, such contamination usually arising from putrefaction or from certain manufacturing industries.

Dust is considered a normal constituent of the atmosphere, as it is always present, arising from innumerable sources.

Dust may be organic or inorganic (mineral) and is lifted by the movements of the air, the organic matter being partially oxidized and the solid particles falling to the earth.

Organic dust does not exist in high altitudes.

Micro-organisms are numerous in the atmosphere of cities, towns, and inhabited dwellings. The number of bacteria in the air is influenced by the action of the winds and the amount of humidity; they are carried some distance by the winds, are washed out of the air by rain or snow, and may be killed by exposure to sunlight.

It is a question still in doubt, whether disease germs (pathogenic organisms) are ever found in the air without being adherent to particles of dust. In considering the presence of bacteria in the air it should always be borne in mind that by far the greater proportion are harmless.

Soil air is different from the air above ground, as it contains large quantities of the products of putrefaction which goes on continually in the soil, and also a larger proportion of carbon dioxide and other injurious gases, the principal one being known as marsh gas.

In caves and wells, the air may have undergone such contamination from putrefaction and chemical changes in the earth as to become highly inflammable and unfit for respiration.

Soil air penetrates dwellings because the air of the buildings being warmer than the surrounding soil, and the warm air having an upward tendency, the air is drawn (aspirated) from the soil into the dwellings; hence newly made soil, particularly in cities, may be considered unhealthy.

Sewer air, in properly constructed sewers which have free ventilation, is not now considered as dangerous as formerly, as it has been found that the air of such sewers differs slightly from the outside air, usually showing a little increase of carbon dioxide and less of micro-organisms. The danger from sewer air arises from any obstruction of the sewer shutting off the ventilation, and causing an accumulation of gases arising from putrefaction.

Carbon monoxide is a poisonous gas arising from imperfect combustion of illuminating gas, from leaking gas pipes, or from defective coal furnaces or stoves.

Gas leaking from the mains in the streets into the soil is often drawn into dwellings by the difference in the temperature inside and outside as cited in the case of soil air. Fatal cases of gas poisoning in dwellings are recorded, where the gas has been drawn through the soil for more than a hundred feet under a well-constructed pavement.

The odor of gas does not always serve as a warning, as the soil through which it passes sometimes retains the odor.

Carbon monoxide produces unconsciousness, heart failure, and at high temperature, convulsions; in small quantities headache and dizziness are followed by insensibility.

Sources of Impurities in the Atmosphere. — The sources of the impurities of the atmosphere may be divided into two classes, gaseous and solid.

Of the gaseous, carbon monoxide and dioxide, marsh gas, hydrogen sulphide, and gaseous organic substances such as ammonia are the most important.

Dust, organic and inorganic, the débris of animal and vegetable organisms, and living micro-organisms constitute the solid form of atmospheric impurities. Among these impurities are included the organic matters from the body, such as epithelium, sweat, the volatile matters from decaying teeth and the digestive tract, and excreta deposited upon unclean clothing.

The impurities due to respiration are the decrease of oxygen, the increase of carbon dioxide, the increase of watery vapor to saturation, and the addition of organic matter. It is said while a large amount of carbon dioxide may escape with very imperfect ventilation, the aqueous vapor and organic matter cling to the surfaces of the room and its contents; the proof of which is the fact that after a prolonged airing an odor of organic matter still remains in such a room.

It is generally conceded that impure air is the most important exciting cause of disease, and that a normal proportion of oxygen in the air is necessary for health, this theory being proven by a well-known fact that among out-of-door workers the death rate is very much lower than among those employed indoors. Pulmonary tuberculosis (phthisis) is especially associated with overcrowding, and the high death rate of jails and barracks, formerly so common, was no doubt due to crowded quarters.

Effects of Bad Air. — The immediate effects of inhaling impure air are discomfort followed by headache, dizziness, and nausea, and if continued, as before stated, with less than 13 per cent oxygen the respiration becomes slow and difficult, perspiration is profuse, and asphyxia and death soon result.

The continued breathing of bad air in lesser quantity causes a gradual loss of health, manifested by pallor, languor, anæmia, loss of appetite, and loss of resistance to diseases, *the last being one of the most injurious effects.*

The air of workshops and factories contains not only the impurities arising from the respiration and perspiration of men, but to combustion from heating and lighting; and to these may be often added overheating and overcrowding, besides lack of personal cleanliness.

Certain occupations expose workmen to impure air from special sources, such as miners, bakers, workers in silk and cotton mills, in bleaching works, in the manufacture of zinc, steel, brass, wall paper, artificial flowers, cutlery, guns, cabinet making, etc.

In factories where hides and feathers are used the dust is of animal origin.

Much attention has been given during recent years to providing sufficient air space and ventilation for workshops and factories, besides apparatus for mechanically removing the dust or fumes arising from the various industries, many states having passed stringent laws for thus protecting workers.

The impurities of the air in dwellings arise from respiration, perspiration, combustion, faulty sewerage, and very largely from bad housekeeping, which permits

uncleanliness of the dwelling and its occupants. With fairly good ventilation the air of a dwelling cannot be pure if it be filled with dusty carpets, curtains, and walls; if both bed and body clothing be soiled, if cellars, pantries, and ice boxes are filled with decaying food and unclean utensils, if bath rooms and kitchen sinks

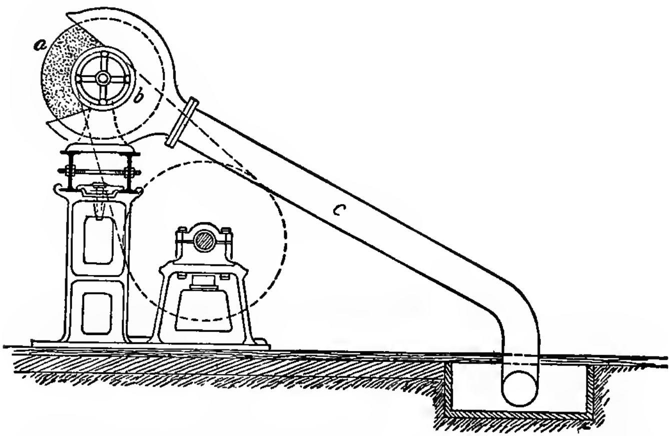


FIG. 15. — Apparatus for removing dust from the air in manufacturing establishments: *a*, emery wheel; *b*, hood over emery wheel; *c*, exhaust shaft. (Bergey.)

are dirty and drain pipes filled with an accumulation of grease and other filth. It is not too much to say that most dwellings would have better air if there were less furniture and decoration, and more attention paid to everyday cleanliness.

In hospitals the sources of impurities in the air are the same as in dwellings, multiplied by many degrees and to which may be added the manifold germs of disease and exhalations from the bodies of sick persons, thus requir-

ing especial care in guarding against overcrowding and overheating, and in providing perfect cleanliness in every detail of housekeeping and nursing.

In schools and other assembly rooms the impurities of the air are mainly due to overheating and overcrowding, together with the effects of respiration, perspiration, and combustion.

The impure air of large office buildings, courthouses, railway stations, day and sleeping cars is aggravated by the almost universal fault of overheating, which, taken together with the impurities of respiration, combustion, uncleanliness, and faulty ventilation, produce an enormous volume of foul air.

Section II

CLIMATE, VENTILATION

The climate of a locality depends mainly upon its distance from the equator, its height above sea level, its nearness to large bodies of water, and its prevailing winds.

Given the same distance from the equator and the sea, a mountain locality will have a cooler climate than a lower level.

The middle of a continent is subject to extremes of heat and cold unknown on the seacoast, while the latter is much more humid.

The prevailing winds are governed by the presence or absence of mountain ranges.

Climate is usually designated as temperate, polar, or tropical.

Climate and Health. — In tropical climates disorders of the liver, digestion, and nervous system are common, while in the polar climate the digestion is good, the nervous system sluggish, muscular development greater than in the tropics, but lung and kidney diseases are prevalent.

The temperate climate is therefore the healthiest, as there is less continued strain upon the organs of the body than in the extremes of heat and cold of the tropics and polar regions.

The effects of a tropical climate upon persons coming from a temperate zone are bleaching of the skin, sometimes due to anæmia but generally ascribed to the profuse perspiration, sluggishness, and relaxation, loss of appetite, impaired digestion due principally to drinking too freely to supply the loss of fluids by perspiration, and the common excessive use of alcohol. It is said that the tropical climate acts especially unfavorably upon the female organism.

The infectious diseases, yellow fever, cholera, plague, dysentery, and malaria, prevail in tropical climates. The influence of climate upon certain diseases is well known; that of such regions as the Rocky Mountains, southern California, and the mountains of North Carolina, which are particularly dry, being beneficial to tuberculosis, while the damp cool climate of England and the region of the Great Lakes of the United States is no doubt the cause of the lung and kidney diseases which prevail with alarming frequency during the winter months.

Season exerts a marked influence upon mortality; deaths from diseases of the respiratory system occur

more frequently in winter and those from intestinal diseases during the summer, notably typhoid fever and the infantile diarrhœas.

VENTILATION

By the term "ventilation" we understand a process by which a constant supply of pure air is introduced into buildings or rooms, with a simultaneous discharge of impure air. But it is well for us to understand that at the best it is impossible to provide as pure air indoors as outdoors, it being held that any system of ventilation which limits the amount of carbon dioxide to 6 or 7 parts in 10,000 may be called good; and also that no system of ventilation, no matter how perfect, can do much more than remove the impurities due to respiration and combustion; the solid and organic matter due to filth can only be removed by the practice of cleanliness both inside and outside the building.

Given cleanliness of a building and its contents, the need for ventilation is somewhat limited, a point of much importance in a climate like that of the northern part of the United States, where artificial heating is required for more than half of the year.

The amount of air required is from 30 to 50 cubic feet per minute for each person to maintain a fair degree of health; less than 30 will produce impaired vitality. At such a rate a person in a confined space would require 3000 cubic feet of air hourly properly to dilute the impure air from his own respirations.

The supply of fresh air must be constant to prevent an accumulation of impurities which would occur were the air replaced only by an occasional renewal.

The minimum cubic space required for each person at the rate of providing 3000 cubic feet of air hourly would be 500 cubic feet, allowing one fourth more in hospitals and sick rooms. But this would require that the air be changed six times hourly — a process almost entirely impracticable in our winter climate.

Changing the air three times hourly with an allowance of 1000 cubic feet to each person may be carried out under favorable circumstances, but in winter this is impossible in the majority of dwellings.

The space allowed for each person may be less for large assembly halls than for living rooms, as it is much easier to change the air without perceptible draughts in large rooms than small, and also for the reason that an assembly hall is occupied for only a comparatively short time.

To ventilate without draughts in small rooms presents many difficulties, as diffusion takes place much less rapidly than in larger spaces and the inlets and outlets are necessarily very near together.

Natural Ventilation. — The natural forces which are constantly at work at all times and to a great extent control ventilation whether buildings are provided with special apparatus or not, are diffusion, and the difference in the density of air at different temperatures.

The diffusion of carbon dioxide and other gaseous impurities from a room into the outer air takes place not only through the windows, doors, and crevices, but through the walls and ceilings, the amount of diffusion depending upon the porosity of building material, the difference between the outdoor and indoor temperature, and the direction and force of the wind.

Dampness in the walls prevents diffusion, which is one reason for the unhealthfulness of damp dwellings.

The action of the wind works in two ways: by perflation (blowing through) and aspiration (drawing out), as the wind blowing across a chimney or ventilating flue creates an upward current. Thus a fireplace affords a means of ventilation. The movement of air is caused by the difference in the weight of masses of air of different temperatures, the warmer air being lighter expands and rises, being displaced by heavier and colder air; the greater the difference in temperature of these masses the more rapid the movement.

The chief force in natural ventilation therefore is movement of the air.

The more tightly fitting windows and doors are made, and the more impervious the walls are built, the more obstruction is offered to natural ventilation, but inlets and outlets properly placed afford assistance to natural ventilation which may be supplemented by the temporary opening of doors or windows.

Inlets and outlets for ventilation should be placed according to the size, position, and method of heating the building or room, as no hard and fast rules are possible which would cover all conditions; the intake for pure air entering the building should, however, always be raised some distance above ground to avoid street dust. By a series of experiments the following general conclusions may be drawn; that the best results obtain when the inlet for a room is on the side of a room near the top and the outlet is in the bottom near the center. In order to prevent draughts the movements of the inlet air must be slow, agreeable in temperature, and its

humidity neither too high nor too low. The current of air may be broken by subdividing the openings of both inlets and outlets and especially the inlet opening.

Unless they are heated artificially the inlet flues should not be placed in the outside walls, as the cooling of the column of air may produce down draughts. The air flues or shafts should be circular in shape with smooth inside surfaces and with as few angles as possible which interfere with air currents.

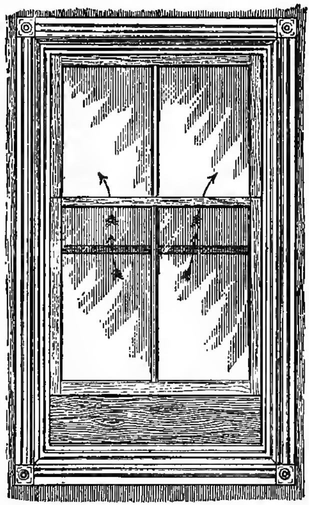


Fig. 16. — Partial ventilation by means of a board placed under the lower window sash.

It should be borne in mind that unless air shafts are properly placed the air currents, following the natural laws which govern them, may be reversed, and ventilation be entirely defeated.

Partial ventilation may be secured sometimes by placing a board 4 or 6 inches wide fitted under the lower window sash which prevents a draft by directing the current of air upward between the two sashes.

A screen frame covered with cheesecloth or lightweight flannel, fitted at either the top or bottom of the window provides a partial ventilation without draught and excludes soot and dust.

There are many patented devices for window ventilation, such as sliding or revolving panes, — some satisfactory and others useless.

Mechanical Ventilation. — In large buildings, such as hospitals, theaters, and schools, mechanical ventilation becomes a necessity, the especial advantage being that thorough ventilation may always be accomplished in any and all variations of weather.

Two systems of mechanical ventilation are used: propulsion or "plenum" system, and abstraction or "vacuum" system.

In the *plenum system* the air is drawn into a box by the revolving blades of a fan, and propelled through a central shaft with the necessary branches leading to various parts of the building; when desired, the air may be first received into a chamber and heated. The air supply is regulated by the number of revolutions of the fan.

The abstraction or vacuum system abstracts the air through pipes leading to a central shaft, where it is drawn in by a fan and discharged outward. This system is said to be less satisfactory in that, by the vacuum created, cold air is drawn in through all crevices, causing draughts and cold floors to prevail; likewise more fuel is required.

A combination of both plenum and vacuum systems has been found most satisfactory.

The filtration of air for certain buildings is carried on to some extent, — the filtration being either through water or cloth.

"In the building of the American Bell Telephone Co. in Boston the air is drawn into and through a system of large cotton bags 30 feet in length, in which all dirt and dust is retained. About a peck per month is separated in this way from the air, which is drawn, not from

the street level, but far above it. An analysis, chemical and microscopical, made in April, 1897, showed 22.67 per cent organic and 77.33 of inorganic matter; the material consisted of all manner of animal, mineral, and vegetable substances ordinarily present in the dust of cities."[1]

Section III

HEATING, LIGHTING

The heating and ventilation of buildings are so interdependent that they must necessarily be considered in connection.

Fresh air in abundance is required for the process of combustion, to replace the impure air arising from the consumption of oxygen by combustion, and to replace the heated air which escapes.

Required Temperature. — An average temperature of 70° F. for living rooms and 65° F. for bedrooms is considered the healthiest degree of warmth for vigorous adults, with a slightly higher temperature for children and the aged; but the warmth required by different individuals in good health varies to a wide degree, and inflexible rules are impossible to follow. That overheating is a serious fault in the majority of buildings is evident, and it is further noticeable that men endure or require a much higher degree of heat than women.

Systems of Heating. — There are three systems of heating in common use: direct radiation, indirect radiation, and direct-indirect radiation.

[1] *Practical Hygiene,* Harrington.

Direct radiation is from a fireplace, or from a stove or steam coil in the room. Heat from a stove or steam coil is less radiant than from a fireplace, as the air is heated and brought into circulation in the room, known as heating by convection.

Indirect radiation is accomplished by heated air being carried by flues from a central heating point to various rooms of a building, such as a hot-air furnace.

Direct-indirect radiation is where the heating surfaces are in the rooms, with the addition of an arrangement for admitting outside air which may be cut off, making *direct radiation.*

Fireplaces heat almost entirely by radiation, and while removing the impurities of combustion to a large degree, they heat only one side of a body; there being little convection, they produce draughts, a large amount of heat is lost through the chimney, and they are liable to smoke with certain winds; but as a part of other heating systems or to be used in moderate weather, and as a promoter of cheerfulness, particularly in a sick room, the fireplace has a distinct value.

Stoves are an economical mode of heating, but the dust and extreme dryness of the air are very objectionable, besides the great amount of labor which must be expended in caring for them.

Hot-water and steam heating systems each require an especial piping for conveying the hot water or steam to the various parts of the building.

It is said the installation of the hot-water system is more expensive than for steam, but the expense of running is less. Hot-water heating is more suitable for small buildings, such as dwellings, and steam heat for

the large buildings, such as hospitals, large apartment or office buildings, courthouses, etc.

Steam heating in moderate-sized buildings is usually by direct radiation, the radiators being placed in each room; but in the large buildings indirect radiation is employed by placing the radiators in a box in the ventilating flue, preferably near the top, which may be regulated by dampers sometimes controlled by thermostats.

Again, in many more modern buildings of great size, the radiators are arranged in stacks and the hot air propelled by fans through the flues to every part of the building, which enables fresh air at a certain temperature to be supplied, being considered the best method of heating large areas which has yet been devised.

The hot-air furnace is not suitable for the larger buildings, but for an ordinary dwelling is an economical and satisfactory means of heating.

The dryness of the air is an objection to the hot-air furnace which is not difficult to overcome. The fact that ventilation is obstructed when the heat is cut off is the principal objection to the hot-air furnace, otherwise the ventilation should be very good if the inlet opens to the outside air some distance above the ground level. The practice of having the inlet for fresh air open directly into the basement is obviously dangerous, particularly in cities, where the basement floors and walls are not impervious and may admit large quantities of soil air mixed with escaped gas from leaking pipes.

The position of flues and registers from hot-air furnaces should be decided by the prevailing winds, it being

said that hot air will move less than ten feet against a cold wind, and will easily carry fifty feet with the wind.

Electrical heating systems have not yet been perfected sufficiently to put them within the means of people of moderate incomes, although electricity is used in a small way for heating small quantities of water, cooking single articles as with a chafing-dish, for ironing, and for supplying heat for the various hot applications used in hospitals.

Electric fans are employed for assisting ventilation.

Gas heating is employed in certain localities supplied with natural gas, which is used instead of coal in hot-air furnaces and in both hot-water and steam heating systems, giving a very cleanly easy method, as there is no dust nor ashes to remove; but especial attention must be given to ventilation and the adjustment of all gas pipes and burners, to prevent the leakage of gas.

Portable gas stoves and oil stoves are in common use for heating small rooms, and possess the great advantage of carrying easily to the place where needed. The great objection to both is in the consumption of oxygen and the throwing off of a corresponding amount of carbon dioxide, together with the unpleasant odors. Gas stoves may be easily supplied with an outlet pipe carried into the fireplace or window, and oil stoves, by being kept well filled and perfectly clean, may have the odor reduced to a minimum, but in both instances ventilation should receive especial attention.

A small tin oven set upon the top of a gas stove or oil stove will serve for a radiator, and hasten the heating of a room.

The lack of moisture in all heated buildings may be

easily remedied in the household by intelligent supervision, but can seldom be trusted to the care of servants; shallow basins of water put upon the back of stoves or radiators where heating by direct radiation is employed is all that is necessary, but the basins must be kept constantly filled.

The newer steam heating systems for large buildings are usually supplied with a spray of water over the stacks of radiators, which supplies the necessary moisture.

It has been found that in buildings thus equipped the occupants are much freer from coughs and colds than where the air is excessively dry, and also that a lesser degree of heat is perfectly comfortable, which makes a considerable item of economy in fuel.

LIGHTING

Buildings are lighted by the natural method of daylight admitted through windows or artificially by means of burning gas, oil, or candles, or by electricity.

The proper natural lighting of all buildings is one of great importance to health, the direct rays of the sun being one of the greatest factors in promoting vigor of mind and body.

Persons working by artificial light during the day soon become pale and languid, gradually losing mental and physical vigor.

The influence of light upon health has been the subject of extensive scientific research during recent years, leading to much improvement in the natural lighting of new buildings and to the treatment of certain diseases by certain rays of light. The women of the household and hospital should supplement the improved building

arrangements by removing all elaborate window draperies, especially in cities where every ray of light and breath of air is needed and should not be restricted.

Electricity is by far the best method of artificial lighting, as the combustion of gas, oil, or candles adds impurities to the atmosphere, and, except in the case of the Welsbach burners, gives a feebler light. Another serious objection to oil lamps besides the great labor needed to care for them, is in their almost universal improper position in relation to the eyes. The old-fashioned hanging and bracket lamps which put the light in the upper part of the room where it belongs are almost never seen. Standing table lamps without shades should never be permitted, particularly where there are children.

CHAPTER IV

SOIL, WATER

THAT health is dependent to a greater or less degree upon the soil has been a long-recognized fact. That from the soil we derive our drinking water and that nearly all garbage is returned to the soil compels men to seriously consider the relations of the public health to the soil upon which we live.

Soil is a mixture of sand, clay, and other mineral substances to which are added humus or organic matter and living organisms.

The soil is porous and contains varying amounts of air and water, the health of a community depending greatly upon the amount and purity of the soil air and soil water.

The purity of the soil air and water depends upon the amount of organic matter contained in the soil, hence the danger to health from filth deposited upon the soil.

Soil Air. — The composition and entrance of soil air into dwellings have been mentioned in the foregoing chapter on air (see p. 55).

Soil or ground water is rain water which has penetrated the soil and which contains some of the dissolved mineral constituents of the soil as well as decaying organic matter and bacteria derived from the soil.

Damp soil predisposes to diseases of the lungs, rheu-

matism, and malaria, although in all cases the relation is indirect.

Pathogenic (disease) Bacteria in the Soil. — Some pathogenic bacteria, such as the bacilli of anthrax, tetanus, malignant œdema, typhus fever, tuberculosis, cholera, and typhoid fever, are capable of living, and some of them, notably tetanus, of multiplying in the soil.

The position or configuration of the soil as well as the constituents has much to do with health. The high lands being better drained and consequently drier are more healthful than low-lying lands. In the low lands health depends upon the constituents of the soil itself. It is only by the most systematic drainage and disposal of garbage that the modern city escapes the devastations of the plagues which prevailed in ancient times.

WATER

Composition of Water. — Pure water, which is never found outside of the laboratory, is colorless, odorless, and tasteless, of neutral reaction, and composed of 11.11 parts hydrogen and 88.89 parts oxygen, the chemical formula being H_2O.

Water contains a great variety of substances, both mineral and organic, which it derives from the air and soil.

The amount of dissolved mineral matter contained in water depends upon the soil from which it is taken, some waters containing enormous amounts of mineral substances, salt, iron, and lime being most common.

"The permissible total amount of dissolved mineral constituents cannot be stated, but 50 parts in 100,000 are generally held excessive."[1]

[1] *Practical Hygiene,* Harrington.

In falling as snow or rain water absorbs both mineral and organic matter from the air. From the hygienic standpoint water is pure when it contains nothing injurious to health, and impure when it is unfit for domestic use.

Water may be classified into rain water, spring water, river, lake, and sea water, and artesian or deep well water.

Rain water is the purest of natural waters, but it absorbs impurities from the atmosphere through which it passes, hence its purity depends upon the locality of its falling.

Spring water is rain water which has penetrated the soil, and by its action of solution and oxidation may contain the chemical properties of the soil. Springs are divided into two classes, common and mineral, the latter often containing medicinal qualities of great value although unfit for domestic use.

Spring water is usually of lower temperature than the air, and contains few bacteria unless subject to special contamination.

Artesian or deep well water is of the purest, but contains the chemical properties of the strata through which it has passed, which may render it unfit for constant use.

Well water from shallow wells is easily polluted by surface washings and is usually hard, while spring water is soft.

River water and other surface waters such as ponds or small lakes are derived from the rainfall and from springs.

Water passing over rocky soil is less apt to contain organic matter than water which passes over a more porous soil, or stands in marshy places, while water passing over or through sandstone contains more mineral substances.

The quality of surface water therefore depends upon the composition of the soil, season, rainfall, strength of the current, amount and character of surrounding vegetation, nearness and number of human habitations, and other sources of contamination.

Water of Large Lakes. — The composition of lake water is variable, but broadly divided into salt and fresh water lakes.

The water of large lakes such as the Great Lakes of the United States is remarkably pure at a sufficient distance from shore to be unpolluted by sewage.

Sea water is of alkaline reaction and contains many chemical properties rendering it unfit for domestic or commercial use.

Impurities in Water. — The impurities contained in water are those substances which directly or indirectly may be injurious to health, and may be solid or in solution, gaseous, organic, or inorganic.

" It may be laid down as a general rule, regardless of the fact that all impurities do not necessarily breed disease or undermine the health, that all water containing or likely to contain domestic sewage, abundant growths of minute vegetable and animal organisms, decomposing matter of animal origin, dissolved vegetable matter of an inherently toxic nature or undergoing decomposition, or excessive amounts of mineral matter, should not be accepted as fit for human consumption. Especially should we bear in mind that water which is quite free from disease organisms and toxic matter today may contain them in abundance to-morrow." [1]

Mineral matter in water is usually connected with

[1] *Practical Hygiene*, Harrington.

certain disorders such as follow the change from a soft to a hard water, which may cause constipation with an occasional attack of diarrhœa; or the change from a hard to a soft water, which may produce great looseness of the bowels. Goiter, a disease very common in Switzerland, France, and some parts of India, has long been attributed to mineral in the water, but recent investigations have made this theory doubtful, and while evidently due to the water, is not due to its mineral contents. Lead poisoning from the action of water upon lead water pipes occurs not infrequently. Soft water and distilled water are said to be greater solvents of lead than hard water.

Organic pollution of water arises from dead organic vegetable or animal matter and living organisms, which may be either vegetable or animal. The sources of the organic pollution of water are from surface washings, the discharge of sewage into the water supply, or vegetable growths. The three infectious diseases which may be said positively to be carried by water are cholera, dysentery, and typhoid fever.

Yellow fever and malaria were formerly attributed to polluted drinking water, but recent investigations have proven that both are carried by other means. Cholera being an almost unknown disease in this country, the epidemics of typhoid fever concern us most.

Contrary to a prevailing opinion, ordinary sewage pollution does not necessarily cause cholera nor typhoid fever, *the water must contain the specific germs of the diseases.* Formerly it was supposed that the germ of typhoid was found only in the fecal discharges of the patient, but it is now known to be found in the urine

for a much longer period, even after convalescence. In the country these discharges are usually deposited in the privy vault or upon the soil, in either case they are readily washed or filtered into the well or stream affording drinking water. Many outbreaks of typhoid fever have been traced from the locality in which they occurred to villages and towns higher up on the stream, discharging their sewage into the stream.

"In districts where water supplies are obtained from shallow wells, there is probably no more active cause of the spread of this disease than pollution of the soil by cesspools and privies. In such localities the soil is often saturated with the contents of privies into which not only normal intestinal contents find their way, but also the evacuations of individuals suffering from this malady. It is therefore plain that the most important domestic prophylactic (preventive) measures consist in the disinfection of the bowel discharges from all suspicious cases of intestinal trouble and the subsequent disposal of such discharges by some method which will remove them quickly and completely from the neighborhood of human habitations. This latter is to be accomplished in cities only by an efficient sewerage system. In the country, where sewers do not exist, reliance must be placed in the disinfection of the stools and their final disposal upon the soil."[1]

Bacteria are found in all natural waters, but the important hygienic point is to determine whether the water contains the germs of any specific disease. The

[1] For examples of Typhoid Fever and Cholera epidemics, see Harrington's *Practical Hygiene*, p. 379. *Hygiene of Transmissible Diseases*, Abbott.

appearance of water may be extremely deceptive, as polluted water may be clear, sparkling, and odorless. On the contrary, pure water may be discolored from mineral or vegetable causes and frequently has an odor as well as an unpleasant taste.

The purity of water can only be determined in the laboratory.

The amount of water per capita daily supplied in a large number of cities in the United States varies from 300 gallons in Denver to 48 gallons in New Orleans, the average being about 150 gallons; this includes water for all domestic and commercial purposes.

The purification of water is accomplished by physical, chemical, and mechanical means.

Formerly mechanical means only were employed, a water that was clear being considered fit for drinking purposes, but with the knowledge acquired by recent investigations it is now known to be of much more importance to free the water of all pathogenic bacteria as well as of some harmful mineral substances.

Self-purification of water. — That the water of running streams and lakes is largely self-purifying has long been recognized. This self-purification occurs by sedimentation or the settling of solid matter and by oxidation, whereby in its movement the water comes in contact with oxygen, which oxidizes the organic matter; sunlight also destroys some bacteria.

The entrance of pure water from tributary streams dilutes polluted water, rendering it less harmful; many water plants purify water of undissolved organic substances, and pathogenic bacteria may be destroyed by the saprophytic class.

An interesting sample is cited by Jordan[1] of observations made along the Chicago drainage canal and its connecting rivers, the Des Plaines, Illinois, and Mississippi. "In the flow of twenty-four miles between Morris and Ottawa, the river freed itself from a great mass of sewage bacteria with which it was originally laden, and at Ottawa this was not greatly in excess of that found in the flow of tributary streams."

However, self-purification is not sufficient to render water fit for drinking purposes which has been largely polluted.

Chemical purification is employed to cause an insoluble precipitate, which settles, carrying solid matters including bacteria.

Where excessive hardness of water is due to calcium bicarbonate (chalk), lime to the extent of fourteen or fifteen hundredweight to each million gallons of water is used. This is commonly practiced in the south of England, where much of the water comes from chalk beds.

Alum, one grain per gallon, is sometimes employed to purify polluted water. "Although alum in large quantities is undoubtedly injurious to health, it is neither a violent nor cumulative poison; and the proposition that one part of alum in a million parts of water is injurious to health must be regarded as conjective rather than as a matter of proof, or even of probability." (Hazen.)

Chlorin, in the form of chloride of lime, and bromin, in the form of bromide of potassium, are both used, but it has been proven that neither is satisfactory for sterilizing water upon a large scale.

Permanganate of potassium has been used for the

[1] *Journ. Exp. Med.*, December 14, 1900.

purification of wells in India during cholera epidemics. Enough permanganate of potassium is dissolved and poured into the well to give it a pink color, which is repeated every twenty-four hours. The results claimed, however, have been disputed. Ozone applied to water by an electrical apparatus has been found the most efficient chemical method of sterilizing water, but the great cost of operation prevents its extended use.

Water is sometimes treated with borings and scrapings of metallic iron. Both water and iron being agitated by special machinery, a flocculent precipitate results, which settles, carrying the bacteria and organic matter with it; the water is then filtered through sand filters, the result being sterile water, but this also is an extremely expensive process.

Filtration of the water supplies of large cities has been found the most practical and efficient method of purification, and is extensively used in both Europe and America. The first filter beds for a public water supply were constructed in London in 1829 by Simpson to clarify the turbid water.

These beds, which except for unimportant detail were identical with those of to-day, were impervious basins built of stone and concrete with drains at the bottom covered with successive layers of coarse gravel and fine sand to half their depth, the sand forming the upper layer, the polluted water entering at the top. At first it was supposed that these filters acted only in a mechanical way as strainers, but late investigations have proved that not only are solid mineral substances removed and the water made clear, but bacteria and other organic matter as well.

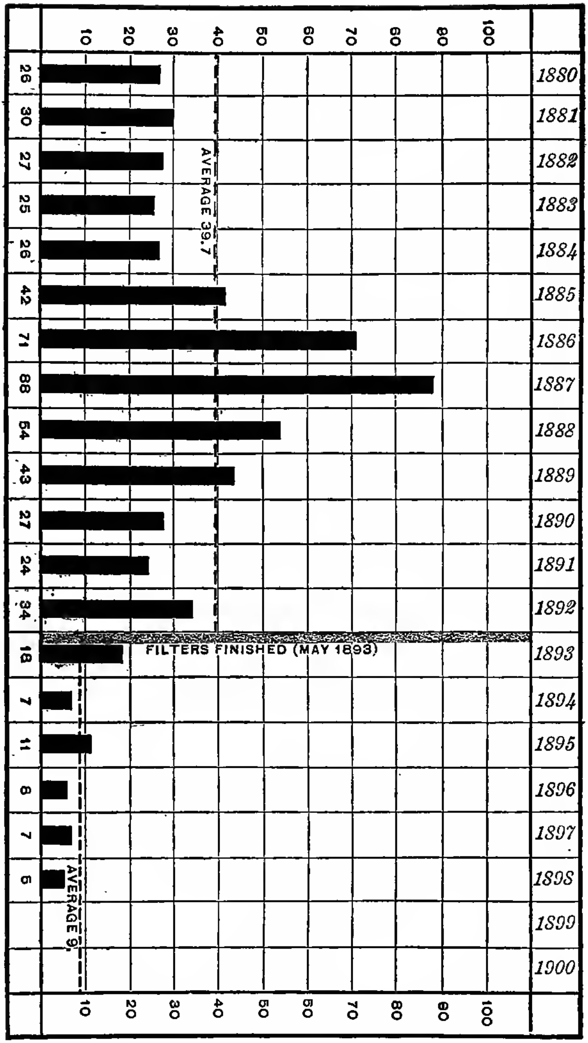


FIG. 17. — Showing the course of typhoid fever in Hamburg before and after filtration of the municipal water-supply. Deaths per 100,000 of population.

It was found that the first water passing through such a filter might be clear but not free from bacteria, but after several hours a fine deposit of sediment began to form upon the surface of the fine sand which proved to be capable of mechanically removing the bacteria. Still further, the organisms themselves "acting as saprophytes decompose the organic matter and even kill the pathogenic bacteria." [1]

Where the water supply comes from a turbid river, preliminary settling basins are used before filtration. It is extremely interesting to note that the modern process of sand filtration is identical with Nature's process which has been going on since the Creation.

Sand filters are cleaned by shutting off the water supply and allowing the basins to drain out completely. The draining of the water draws air through the filter, which oxidizes much of the organic matter. The layer of sediment and an inch and a half or two inches of the upper layer of fine sand is then carefully scraped off. The frequency of cleaning is determined by the amount of sediment which gradually clogs the filter and by the daily bacteriological examination of the water, the latter being of first importance.

"An essential in the management of all large filters is the daily bacteriological and chemical examination of both filtered and unfiltered water. This not only serves to give warning of any accident to the filter, but is necessary, as the best test of the efficiency is the percentage of bacteria which it takes from unfiltered water. Unless a filter is holding back 98 to 99 per cent or more of the bacteria it needs close inspection, although it

[1] *Hygiene and Sanitation*, Egbert.

must be remembered that it is more difficult to get good results from badly polluted water than with one which is comparatively pure."[1]

It is the unanimous opinion of the best authorities that sand filters to be efficient should be provided in numbers to be used in rotation, that the finer the sand the better the filtration, that filter beds should be covered to prevent freezing in winter and the growth of vegetation in summer.

Where the water is very hard it is sometimes treated chemically before filtration. This method is employed in New Orleans, where the water coming from the Mississippi River contains an enormous deposit of sediment. Three basins are employed: the first for settling, the second for mixing with alum, and the third for filtration. The filter beds here require to be cleaned daily or oftener, and the cost is estimated to be $600 daily for 40,000,000 gallons of water. This great labor and expense no doubt accounts for the small per capita allowance for New Orleans.

Domestic Purification of Water. — Properly all cities and towns having a public water supply should be in duty bound to provide pure water, thus avoiding the necessity of domestic purification except in villages and the country, but such a state of affairs has not yet obtained, and meanwhile every well-regulated household not only observes its water supply, but provides some means for purifying it when necessary.

Too much stress cannot be laid upon the prevention of water pollution, whether the supply be public or private. Where water is obtained from shallow wells

[1] *Hygiene and Sanitation*, Egbert.

it is not an exaggeration to say that more than half of them are polluted by the almost universal practice of depositing sewage upon the soil, and from the surface washings from privies and barnyards, all of which might easily be prevented by a little intelligent forethought. Impure water may be sterilized in small quantities for drinking and cooking purposes by boiling. After standing for an hour it should be strained through several thicknesses of clean cotton or linen cloth and boiled for one hour in a double boiler tightly closed. The use of the double boiler prevents the metallic taste so unpleasant when boiled in a teakettle. After cooling, the flat taste may be removed by pouring it several times from one vessel to another until aëration has occurred. Distillation is practiced in many places to secure pure water, such as in the navy and other ships, in hotels, hospitals, and other public institutions. In some distilling apparatus air is admitted

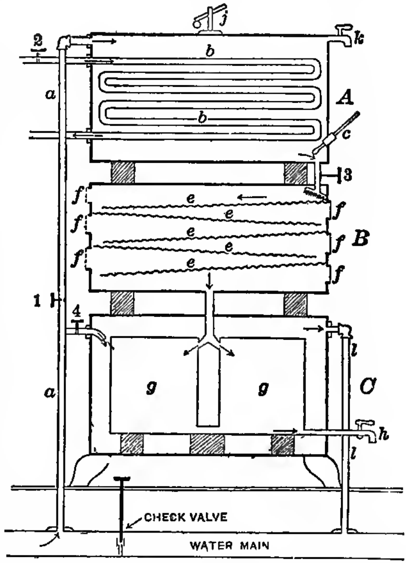


FIG. 18. — Water sterilizer for schools, factories, etc. *a*, supply pipe; *b*, steam coil; *c*, thermometer; *e e*, corrugated and perforated metal plates; *f f*, air openings guarded by cheese cloth; 4, tap to admit cooling water around *g g*, the storage tanks.

into the condensers and aëration takes place with condensation.

Domestic filters of many kinds are upon the market, but the best authorities pronounce most of them useless or worse.

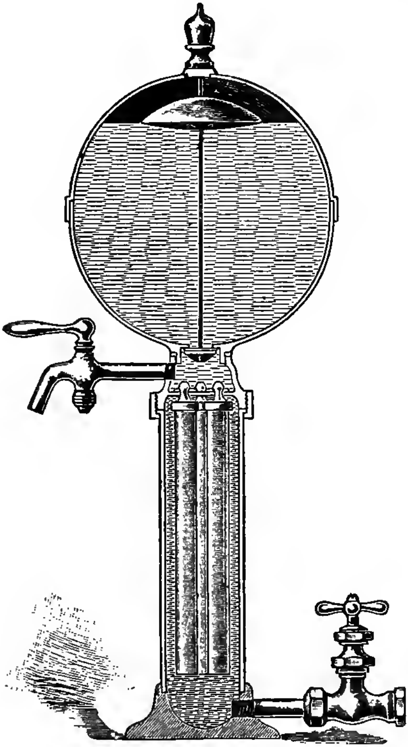


Fig. 19. — Pasteur filter with reservoir for filtered water.

"According to Parkes the requisites of a good filter are: 1. That every part shall be easily accessible for cleansing or renewing the medium. 2. That the filtering medium shall have sufficient purifying power and be present in sufficient quantity. 3. That the medium give nothing to the water favoring the growth of low forms of life. 4. That the purifying power be reasonably lasting. 5. That there be nothing in the construction of the filter itself capable of undergoing putrefaction or of yielding metallic or other impurities to the water. 6. That the filtering material shall not clog and that the flow of water be reasonably rapid."

"The only domestic filters worthy of the name are those which remove mechanically all the bacteria of the water, and at the same time add nothing of their own substance to the water. Such are the Chamberland-Pasteur, the Berkefeld, and others based on the same principle. In these, the filtering medium is unglazed, well baked, hollow porcelain cylinders closed at one end like a test-tube, inclosed within a metallic or glass jacket with sufficient intervening space for the water which enters directly from the tap under its usual pressure or 'head.' The open lower end of the cylinder discharges the water which passes directly through the walls of the cylinders or 'bougies' in the same way it would go through blotting paper. The material is such a very fine strainer that it excludes all suspended matters whatsoever. All these filtering tubes are purely mechanical in their action, and remove none of the matters poisonous or otherwise in solution. While they remove and retain on their external surface all the bacteria, they cannot prevent the growth of the organisms from without inward through their walls, and indeed this occurs so quickly that in order to secure absolutely sterile water continuously it is necessary to *clean and sterilize the bougies daily,* and thus it is advisable to have two sets, one of which can be cleaned while the other is in use."[1]

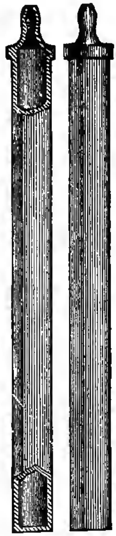


FIG. 20. — Tubes (bougies) of unglazed porcelain for Pasteur filter.

[1] *Practical Hygiene,* Harrington.

The cleansing of filter tubes consists of thoroughly scrubbing the outside, followed by baking or boiling for at least an hour.

It is safe to say that far greater danger to life exists in an unclean filter than is found in any ordinary water supply.

ICE

It was formerly supposed that freezing freed water of all of its impurities; but such is not the case, as many varieties of bacteria, notably that of typhoid fever, retain their vitality in ice for a very long time.

Several epidemics of typhoid fever have been traced to ice cut from polluted ponds and rivers. Artificial ice is often represented as being absolutely pure, but unless it be made from distilled water or sterilized water it is open to the same suspicion as natural ice.

CHAPTER V

SEWAGE, GARBAGE

Domestic sewage is a mixture of the waste from toilet rooms, bath and laundry tubs, and from kitchen sinks, while industrial sewage is entirely different.

The sewage from manufacturing centers often contains chemicals or other substances destructive to fish life, and may contain as much as or more organic matter than domestic sewage, but the latter is liable to hold discharges from infectious diseases which are a menace to the public health.

Removal of Sewage. — Sewage may be removed by water or the dry method.

The removal of sewage by water necessitates a system of plumbing which should be of the best possible method of construction and material. The best plumbing is by far the most economical not only in the health of a household but in the expense of repairs.

A good system of plumbing calls for sound materials, absolutely tight joints, thorough ventilation, and a plentiful supply of water to insure thorough flushing without wastefulness.

To this may be added that plumbing should have good daily care. Many bad odors are attributed to sewer gas which in reality are simply filth, easily removed by a thorough scrubbing and flushing with *clean* hot soapsuds to which has been added a handful of

washing soda. Long-handled sanitary brushes for cleaning the basins of toilet rooms will frequently remove "sewer gas" most effectively.

Modern plumbing is "open plumbing," *i.e.* not put into wall nor between floors, but made with all pipes, joints, and traps in plain sight except where necessary to go through walls or floors, thus giving an opportunity to detect leaks, securing ventilation, and making repairs an easy matter.

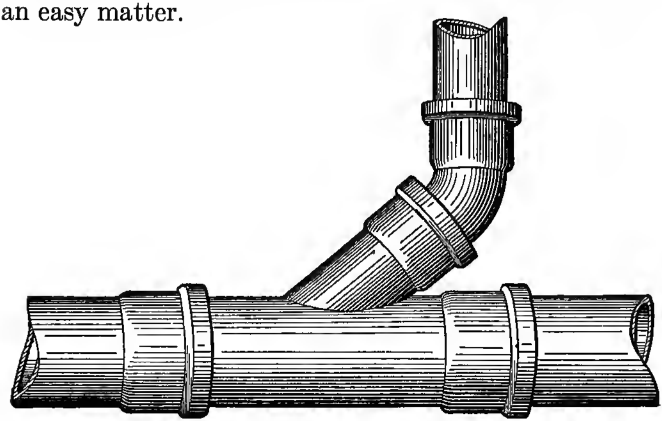


FIG. 21. — Connection of soil pipe to house drain.

The Soil Pipe. — The soil pipe receives the sewage from the waste pipes from bath rooms, laundry tubs, kitchen and housemaids' sinks. This pipe should be four inches in diameter for a dwelling and larger for hospitals or other larger buildings, made of heavy iron, and should be as straight as possible, extending at least two feet above the roof without a cowl to cover it. The unavoidable bends should be obtuse, not right angles, and the entering waste pipes also should never be at right angles.

In warm climates the soil pipe should be on the outside of the wall rather than the inside; it should be so placed as to avoid carrying the waste pipes beneath the floors, where leaks are difficult to detect or repair.

The tendency of modern plumbing is to simplify all fixtures; a great improvement to the soil pipe is in the flanged ends which secure easy adjustment and reduce the danger of leaks to a minimum.

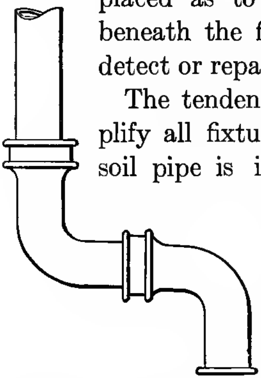


FIG. 22. — Improper bends in soil pipe. (Harrington.)

Traps. — Traps are devices to prevent the return of sewer air through the waste pipes into the building. The simplest trap is made by a bend or bends in the pipes, downward in a horizontal pipe and a figure S in a perpendicular pipe.

When water passes through the pipes, some of it will be retained in the depressed parts, causing a water seal, which prevents the return of sewer air.

There are several other traps of excellent design in common use, the ball-trap, bell-trap, bottle-trap, Anti-D trap, and Mason trap. Each and every waste pipe from all bath rooms, sinks, wash basins, and laundry tubs must be trapped, the trap always being put as near the fixture as possible.

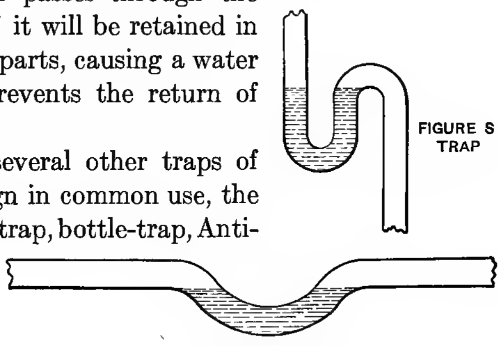


FIG. 23.

Traps lose their seal by siphonage, evaporation, leakage, and the accumulation of sediment in the trap.

Siphonage is prevented by ventilating pipes from the trap, which connect with a main ventilating pipe.

Evaporation of the water seal usually results from disuse, and may be prevented by pouring glycerine or some oil into the pipes when a building is to be closed for some time.

Toilet rooms should always be lighted and ventilated by windows. The old practice of placing such plumbing in unlighted, unventilated closets literally belonged to the dark ages.

Preferably the plumbing should be put opposite the window, which gives a better light for detecting leaks and making repairs.

Wash basins and bath tubs were formerly supplied with overflow pipes opening from the top of the basin or tub; these pipes are particularly objectionable, as they collect filth and soon become foul smelling, and are almost impossible to clean, while in some cases they discharge into the waste pipe *below* the trap, which allows sewer air free passage into the room. The newer arrangement of standpipe overflow is preferable in every way.

Sinks. — Kitchen, pantry, and housemaids' sinks should be made of impervious material, preferably porcelain or iron heavily enameled, or slate. All such sinks require the best of daily care. Housemaids' sinks from the nature of their use should have particular attention to prevent foul odors; they should never be placed in dark closets, and should always be provided with a flushing rim. One of the especial reasons why these sinks

become so foul is because they are too small, and their sides as well as the walls and floors are splashed with slops. Soda solution, about 5 per cent, boiling hot, will remove much greasy sediment and remove most odors. The discharge pipes from all sinks should be in plain sight and never inclosed in cupboards.

With good plumbing and good daily care odors of any kind are never present.

Final Disposal of Sewage. — Sewage is finally disposed of by discharging into the sea, into streams, by the dry method, by chemical treatment, by filtration, by sewage farms or irrigation, and several other methods.

In the country, where no sewerage system prevails, the sewage discharges into a cesspool. If the cesspool is far enough from the well and the soil is porous, the cesspool may be built to allow the fluids to drain away into the soil at once; if not, the cesspool must be built of impervious material which necessitates frequent cleaning, the solid contents being used as fertilizer.

A large majority of towns discharge their sewage *into running streams,* a custom which in time will no doubt be prohibited with all streams which serve as a water supply.

Seacoast towns find the disposal of sewage an easy matter, as the elements of sea water cause a precipitation of solids, and the tide dilutes and carries the impure water away.

Dry Method. — The dry method for the removal and disposal of sewage is known as the earth system, and is used very little except in the country or in the far northern latitudes (Christiania, Norway), where the freezing of water pipes prevents the removal of sewage by water.

The chemical treatment of sewage is accomplished by

passing the sewage through coarse screens and treating it with alum, lime, sulphate of iron, or clay besides other combinations of chemicals. The precipitate, called sludge, is used as a fertilizer, and the remaining fluid is discharged into streams, in some cases being previously sand-filtered as was described for drinking water.

" The conditions necessary for success from chemical treatment are as follows:

" 1. The sewage should be treated while fresh.

" 2. The chemicals should be added to the flowing sewage, and thoroughly mixed with it before it passes into the settling tanks.

" 3. There should be a liberal amount of tank space.

" 4. The arrangements for the removal of sludge should be such as to insure its frequent removal." [1]

Sand filtration of sewage consists of discharging the sewage into especially prepared sand filters which are used in rotation, one half day at a time, to allow for the entrance of oxygen and give the saprophytic bacteria an opportunity to convert the organic impurities into simple compounds.

The land is underdrained at a depth of five or six feet; an acre, it is said, will purify the sewage from 2000 persons, and from 5000 persons when the sewage has been chemically treated or " settled."

By the irrigation method of disposal the sewage is discharged upon the land for fertilizing purposes. This method is employed in a large number of English towns and in Berlin and other German cities.

In the United States it has been adopted in few of the smaller cities except in Colorado and California,

[1] *Principles of Hygiene*, Bergey.

where a number of the cities utilize the sewage for irrigation purposes. Such a method is not adaptable for large cities in this country where adjacent lands are so expensive and not always of the proper quality for the purpose, and if there is not enough land, the soil becomes heavy with filth, and unproductive as well as dangerous. Also in cold climates such an arrangement is not satisfactory. In Madras, India, the climate being very hot, eight crops a year are taken from the "sewage farms." It is said that the health of those living near the sewage farms does not suffer.

Irrigation upon a small scale for country houses or small hamlets consists of discharging the sewage into a reservoir through a wire basket, and from there through three or four outlets made of porous drainage tiles as in any underdrain; in this way the sewage is utilized for fertilizing lawns or gardens. Several other methods and combinations of methods are used, notably the Cameron "Septic Tank" process, which, contrary to the usual procedure, treats the sewage after it has been stored away from light and air until the organic matter has broken down, when it is drained into open air tanks and filtered.

GARBAGE

By garbage is meant all the waste material from a household, such as kitchen refuse, ashes, sweepings, paper, old shoes, dishes and cooking utensils, clothing, etc. Of these the kitchen and stable refuse in large cities are the most important, as any accumulation soon becomes a menace to health.

In well-regulated cities, kitchen slops are kept separate from ashes and other dry refuse, the former

being collected daily and the latter twice or thrice weekly.

The following form of ordinance covers the regulations in force in New York, Boston, and other cities:

"1. That it shall be unlawful for any person or persons to keep in his house or on his land any kitchen garbage or offal unless the same is placed in water-tight vessels free from ashes and other refuse matter (except food cans and food bottles).

"2. No person shall place or keep in or near any building, ashes or cinders in such a manner as to cause fire, nor mix them with other substances nor place or keep them except in metallic vessels so placed as to be easily removed.

"3. All other refuse such as paper, rags, excelsior, straw mattress, old clothing, pasteboard boxes, carpet and other household waste shall be kept in suitable vessels free from ashes and garbage, or in bundles firmly fastened so as to prevent rubbish from being scattered in handling, and protected from the weather until collected by the proper authority.

"4. Ashes placed out for removal shall be moistened sufficiently to keep down the dust while handling and placed within 4 feet of the building line in vessels which hold their contents without spilling; shall be placed out only on the day set for their removal, and taken in when emptied of their contents."

Disposal of Garbage. — There are several methods for the final disposal of garbage.

In the country it is a simple matter if properly managed, as all kitchen refuse may be fed to poultry or farm animals, all dry refuse may be easily burned out-of-doors,

and cans, bottles, and old iron buried, where tin and iron speedily disintegrate. Glass should always be buried to prevent accident to the feet of both men and animals. In large towns and cities, however, the disposal of garbage becomes a serious question both from a hygienic and an economic standpoint. It is safe to say that one half or more of the enormous expenditure now required of most cities might be avoided if every household and manufactory looked after its garbage as it might.

A large amount of kitchen and other refuse could easily be burned in the range or furnace, and if done immediately, would give rise to no worse odors than come from cooking.

An ingenious device for burning kitchen refuse is used in many households, consisting of an enlarged portion of the pipe of the kitchen range, having a door, into which is put a wire basket containing the refuse, which is soon dried of all moisture and reduced to a charcoal and may be used for fuel. No odors escape into the room, and there is no interference with the draught.

For hospitals and other large institutions, portable furnaces have been devised which are simple and satisfactory, eliminating bad odors and requiring little extra fuel.

The garbage from large cities is dumped into the sea or upon the land, the kitchen refuse is sometimes sold to farmers for feeding to swine, or the whole is sorted and what cannot be sold or utilized is destroyed or reduced in especially built furnaces called "destructors."

Dumping garbage into the sea is particularly objectionable, as with favoring winds and tides a large proportion of it is thrown upon the neighboring beaches, where it is not only unsightly and offensive, but puts an end to sea bathing.

Dumping upon the land is perhaps a shade worse, as it becomes offensive to a vast area which surrounds the "dump grounds."

The disposal of slops or "swill" to farmers is also offensive, giving forth foul odors and usually leaking along the highway. This practice usually means that such slops must wait for cartage, which results in their putrefaction and accompanying indescribable odors.

Incineration has been successfully carried on in England for many years.

The garbage is sorted and much of the refuse, such as old rubber, leather, and woolen goods, is sold; also the solder from tin cans. Old furniture, paper, and pasteboard are used for fuel in the furnaces which burn the other garbage. These furnaces not only cremate the refuse but destroy the foul vapors and gases arising from the combustion; this point is essential, otherwise they become public nuisances. It is said that the experiment has failed repeatedly in the United States for this reason, although where properly managed the process has proven entirely satisfactory.

The reduction of kitchen garbage is accomplished by taking the garbage while perfectly fresh and allowing most of the moisture to drain into the sewer. Live steam is then turned into it for six hours, when it loses about three fourths of its weight in vapor, which is turned

into condensers and finally into the sewer. The grease is removed from the remaining solid matter, which is then dried and sold for fertilizer, both being a source of considerable revenue.

Large incinerators or reduction works should be located at some distance from the city, as foul odors cannot all be eliminated.

CHAPTER VI

CAUSES AND DISSEMINATION OF DISEASE

Pathology is the science which explains the origin, causes, history, and nature of disease.

Etiology is the subdivision of pathology which treats of the causes of disease.

Prophylaxis is the use of precautions to prevent disease; "its first function of suppressing or removing predisposing conditions is accomplished by *sanitation;* the second, that of destroying or modifying exciting causes, is carried out by *disinfection*. . . .

"We may, therefore, say that sanitation is the defensive and disinfection the aggressive part of prophylaxis."[1]

The causes of disease are usually broadly divided into two classes, — direct or exciting causes, and indirect or predisposing causes or conditions.

Of the **direct causes** there are chemical, such as poisons; physical, such as heat or cold; mechanical, such as injuries; and vital, such as the parasites and bacteria of certain specific diseases.

"An organism capable of producing disease we call *pathogenic or infective*, and the process by which it produces disease we know as *infection*. Diseases therefore that depend for their existence upon the presence of bacteria in the tissues are *infectious* diseases."[2]

[1] *Hygiene and Sanitation*, Egbert.

[2] *Hygiene of Transmissible Diseases*, Abbott.

The indirect or predisposing causes of disease are age, sex, heredity, race, occupation, and habits. As an illustration "the direct cause of tuberculosis is *Bacillus tuberculosis*, while the indirect or predisposing causes may be numerous — as age, race, occupation, unsanitary surroundings, and heredity."

Resistance to Disease. — Individuals vary greatly in their degree of resistance to disease. It is known that certain cells and substances of the blood called *opsonins* are antagonistic to pathogenic bacteria, — "the individual infected owes his resistance to four main protective powers of the blood. These four protective agencies are in character: (1) bactericidal, or having the power to kill bacteria; (2) bacteriolytic, which includes not only the power to kill but to dissolve bacteria; (3) agglutinating, or possessing the power to produce clumping of bacteria; (4) phagocytic, or the power of leucocytes (white blood corpuscles) to engulf and digest bacteria."[1]

The degree of resistance to certain disease germs is determined by the examination of the blood and is known as the patient's opsonic index.

Anything which lowers the general health of the individual, such as dissipation, exposure, lack of food, overwork, or unsanitary modes of living, must necessarily lessen the resistance or, as it is expressed, lower the opsonic index. This is commonly illustrated when certain infectious diseases such as scarlet fever or typhoid fever are present in a community. Not all children

[1] See *Opsonic Index* and *Vaccine Therapy* by Ruth Vail, M.D., and Mary C. Lincoln, M.D. *American Journal of Nursing*, Nov., 1907.

exposed to scarlet fever at the same time contract the disease, neither do all persons who drink typhoid-infected water or milk have typhoid fever, the reason being in the difference of the susceptibility in different individuals. A person who is not susceptible to the pathogenic (disease) germs of a specific disease, such as smallpox, is said to be immune. Immunity may be natural or acquired; natural in the case of man's resistance to hog cholera and of cattle to typhoid fever. Acquired immunity usually follows one attack of certain infectious diseases, as in smallpox, scarlet fever, or yellow fever. Vaccination to prevent smallpox produces an acquired immunity. The use of an antitoxin serum to prevent diphtheria is also an example of acquired immunity, which is temporary, usually lasting about three weeks.

Preventive inoculation with sterilized cultures of the bacilli of typhoid fever, bubonic plague, and cholera has been practiced to a limited degree with varying success.

Age.—The highest death rate occurs among the very young and the very old — before five and after sixty-five years of age.

Young children suffer from disorders of digestion, catarrhal affections, congenital (existing at birth) defects, the effects of bad air and lack of cleanliness, and certain acute diseases, as scarlet fever, diphtheria, measles, and chicken pox.

Tuberculosis in many different forms also affects children as well as adults, it being one of the diseases common to all ages.

Typhoid fever occurs most frequently between the ages of fifteen and forty-five.

Erysipelas, smallpox, and typhus fever are common to all ages.

Hughes cites "heart, kidney, digestive disorders, and cancer as common to middle age; degeneration of the heart and blood vessels to old age."

Persons leading regular lives with proper food, shelter, cleanliness, and clothing may be comparatively safe from disease, while on the contrary bad air, overcrowding, bad or insufficient food, intemperance, exposure, and unsanitary occupation lower the vitality and resistance, and render men susceptible to sickness.

Sex. — The statistics of general death rates show almost uniformly a lower rate among women than men; which is explained by the fact that the daily life of men exposes them more to disease and accident.

Race. — Certain differences in the susceptibility to disease are observed in the races, this being particularly noticeable in comparing the whites and blacks.

The negro is less susceptible to malaria and yellow fever than the white man, but is more liable to cholera, while the Chinese are the least susceptible to cholera.

The immunity of the Jews from disease and their longer duration of life has been observed in many countries.

Occupation. — Certain occupations predispose to disease by the conditions surrounding them.

The inhalation of dust from fabrics, minerals, and hard woods are conducive to diseases of the lungs, while singularly enough the dust from coal seems to be harmless. Dust also is a carrier of infection.

Soldiers, sailors, and fishermen are exposed to extremes of temperature and moisture.

The overwork and underfeeding common to many occupations is another important factor in causing disease.

Lead poisoning occurs with painters and plumbers, "brass-founder's ague" with workers in brass and zinc, while other chemical poisons are common to dyers and workmen using arsenic and the anilin dyes. The inhalation of gases from iodine, ammonia, chlorine, and many other chemicals used in various industries is more or less injurious to health.

Occupations which compel a cramped position, especially when in dark, badly ventilated rooms, are a menace to health.

Crowding. — It has long been a matter of observation that the greater the density of population the higher the death rate.

Overcrowding is a necessary condition of poverty which usually entails, besides poor and insufficient food, bad air, lack or entire absence of facilities for bathing or laundry work, imperfect lighting, and the easy dissemination of infectious diseases, owing to close contact.

"The more crowded a community, the greater, speaking generally, is the amount of abject want, of filth, of crime, of drunkenness, and of other excesses, the more keen the competition, and the more feverish and exhausting the conditions of life. Moreover, and perhaps more than all, it is in these crowded communities that almost all the most dangerous and unhealthy industries are carried on. It is not so much the aggregation itself, as it is these other factors which are associated with aggregation, that produce the high mortality of our great towns, or other thickly populated areas." (Ogle.)

Heredity may be defined as the influence of parents

upon offspring. The question of the direct transmission of diseases from parent to child has long been a subject of controversy.

"In predisposing to disease heredity manifests its influence more through the transmission of a peculiar habit of body than by the transmission of the disease itself. . . . In some families we observe a peculiar tendency to nervous diseases, as to epilepsy or insanity; in others to cancers and tumors; in others to scrofula and other tubercular manifestations. Again, families are encountered that are endowed with a marked predisposition to acute diseases and in others there is an equally marked resistance to them. In short, the inheritance of a tendency to, or immunity from, disease is due fundamentally to the same process, through which peculiarities of a physical, moral, or mental nature are transmitted."[1]

The season exerts an influence upon the prevalence of certain diseases.

The summer months show a large proportion of diseases of the digestive tract, especially in young children, probably due to the speedy decomposition of milk, meat, and perishable fruits and vegetables.

During the colder months, catarrhal affections, acute infectious diseases, and diseases of the respiratory system are more prevalent. It is still a question how much of this winter illness is due to the cold and moisture, and how much to the effects of lack of ventilation and cleanliness, which are common in winter.

Malaria and typhoid fever are both more prevalent in the early autumn than during the rest of the year.

[1] *Hygiene of Transmissible Diseases*, Abbott.

Dissemination of Disease. — In all contagious and infectious diseases the transfer of the disease germs is accomplished either directly from a patient to another individual, or indirectly through the air, water, food, or insects.

Air-borne Germs. — To this class belong the eruptive diseases, such as measles, scarlet fever, smallpox, erysipelas, chicken pox, also diphtheria, tuberculosis, and mumps. Besides the danger from the discharges and secretions being deposited upon bedding, floors, or utensils, and becoming a direct menace to others, there is the double danger of such discharges becoming dried and blown with dust to greater or less distances, and the still greater danger of the so-called "droplet" infection. It has been demonstrated that in talking, coughing, sneezing, and even in rapid breathing numerous germ-laden bubbles or droplets of mucus or saliva pass into the air, where they may float about for some time. In the case of pulmonary tuberculosis the greater danger would then be from patients still able to walk about rather than with the bedridden.

Air-borne infection is, therefore, most dangerous in close, badly ventilated rooms.

Water and Soil. — Infections borne by water are typhoid fever, cholera, and dysentery. The soil also may bear the bacilli of tetanus (lockjaw), cholera, and typhoid fever.

Food. — Infections borne by food, such as milk, meat, oysters, and fruit, are tuberculosis, typhoid fever, cholera, and the summer diarrhœa of children.

Insects. — Infections borne by insects are malaria, yellow fever, typhoid fever, and tuberculosis; mosquitoes, house flies, and bedbugs being the common carriers.

In the case of mosquitoes, which carry malaria and yellow fever, the person is infected by the bite of the insect; while house flies and bedbugs carry the disease germs upon their feet and bodies, and by their contact with water, food, or eating utensils convey it to other individuals.

In Cuba, yellow fever and malaria have been entirely stamped out by the destruction of the mosquitoes, which was accomplished by drainage, by the use of petroleum upon the surface of standing water, and by laws forbidding any vessels for water being left standing open. It was found that the peculiar type of mosquito which serves as the carrier of malaria and yellow fever breeds more frequently in open vessels of standing water than in marshy places.

Vermin such as rats and mice are considered a grave source of danger in carrying cholera and bubonic plague.

Domestic pets such as cats and dogs no doubt often carry in their fur the germs of scarlet fever, smallpox, and other eruptive diseases.

Inoculation is the introduction of a specific virus into the system. For example: from the bite of a poisonous snake; stepping upon a nail or other sharp object often carries the germ of lockjaw (tetanus) into the system; certain loathsome infections are contracted from the use of unclean public drinking cups and toilet rooms. These are especially dangerous when there are any abrasions (breaks) in the skin, and are often contracted by handling unclean objects and then rubbing the eyes, or using the pocket handkerchief or toothbrush, or eating from the hands without first washing them.

The infections by inoculation are smallpox, leprosy,

ophthalmia (inflammation of the membrane of the eye), tetanus, anthrax, tuberculosis, hydrophobia, and pus infections (pyæmia and septicæmia), besides many others. Clean hands, clean handkerchiefs, and clean eating and drinking utensils will prevent many infections.

Disease is said to be *epidemic* when it prevails in a community ; it is *endemic* when it is peculiar to a people or a nation; and *pandemic* when it is widespread over more than one country. Influenza is the best example of a pandemic disease.

CHAPTER VII

PERSONAL HYGIENE

Good health of mind and body depends upon the perfect work performed by all of the organs of the body, and in order that these organs may exercise their proper functions the individual must lead a rational, hygienic life. No hard and fast rules can be made which will fit every person, but certain general principles must be observed by all; otherwise the penalty is paid in loss of health.

The lack of understanding of the work done by the organs of the body causes a large proportion of people to have unreasonable fears of disease; such persons will be afraid of fresh air which they think causes them to "take cold," whereas they should be afraid of overheated, illy ventilated rooms, the air of which is full of germ-laden dust; but it is almost impossible to convince them that open bedroom windows and cold baths *prevent* instead of causing so-called colds.

Overwork is another bugbear of the uninformed; while in many cases the fear of overwork is a more polite name for laziness. Still there are many persons with the best of intentions who would be in far better health if they were compelled to work. Indolence both mental and physical, causes as much illness as overwork. When overwork does occur, it is usually the result of concentration upon one particular kind of work to the exclusion of all other interests, and of rest and recreation and rational

exercise, together with bad or insufficient food. Factory workers upon meager wages and the mothers of large families afford the best examples of such conditions.

Other common errors are the almost universal habits of overeating, fast eating, and lack of mastication ; from these bad habits arise innumerable disorders which in time may become serious, and all of which might be avoided by the exercise of self-restraint and a little common sense.

Habit is defined as disposition, and a tendency to repetition.

All human beings show an early tendency to form habits either good or bad; the young infant within a few weeks will easily conform to regular habits of eating and sleeping, and on the contrary quite as early learns that by crying he will be fed, or taken up or rocked in his cradle.

Good mothers and good nurses teach an infant such regular habits that he does not overeat nor demand to be taken up while awake, but will be contented to regularly eat, sleep, and grow, which is the best for him.

On the contrary it is a common custom to feed the baby whenever he is awake or cries, and to rock him or walk with him, until by the time he is three months old he is suffering from indigestion from overeating, is nervous and irritable from irregular hours of sleeping and too much handling, and these bad habits increase with their indulgence until when he has grown to be a man, his habits are so confirmed that he makes no pretense of controlling his appetite nor his temper.

The best thing which can befall all of us while we are very young is to be taught good habits of regularity,

self-control, cleanliness, and how to work, for with the observance of these we may reasonably expect to make healthy, happy, useful men and women.

Habitation is a great factor in the preservation of health. The subject is considered elsewhere (p. 119).

Cleanliness of body is equally important with cleanliness of surroundings ; a clean, wholesome body not only stimulates physical vigor, but produces mental activity as well.

It is very seldom an active mind is associated with an unclean body, while moral delinquency is almost invariably coupled with personal uncleanliness.

The mental and moral inertia of the "unwashed" is in daily evidence in all walks of life. It is an easy matter to teach a child to be clean, but adults are hopeless unless the appeal to their vanity has an effect.

Baths *play an equally important rôle in the prevention and cure of disease.*

Frequent baths, daily if possible, for cleanliness, and the cold shower in the morning, with an abundance of clean clothing, are a necessity as well as a luxury.

Houses without running water may easily have plenty of cistern water, and with a portable tin tub frequent baths may be taken with very little trouble.

Children who become accustomed to the warm bath for cleanliness, followed by a cold shower, seldom depart from their good habit in later years, but many adults are unable to begin the cold shower baths.

Hot baths relieve the muscular soreness following great exertion or fatigue, while a cold shower bath refreshes greatly.

For nervous irritability in children or adults, a warm

bath continued for 20 or 30 minutes has a quieting effect.

Exercise. — It is essential for the maintenance of health that the body shall be exercised in all its parts.

Rational physical exercise develops not only the muscles, but affects all the organs of the body ; the heart, lungs, skin, kidneys, brain, and digestive apparatus are all stimulated. Excessive exercise may injure the heart, but deficient exercise produces obesity (excessive fatness) and tends to weaken the heart and "is a common cause of morbid excitability manifested by irritability of temper, sensitiveness, and that form of nervous unrest known as fidgets." (Harrington.)

The amount and kind of exercise necessary depend upon the occupation and surroundings of the individual. The farmer or gardener will scarcely need further exercise than his work, while the man tied to an office desk or any sedentary occupation needs systematic out-of-door exercise. Golf, gardening, sailing, tennis, wheeling, and horseback riding are usually advised for those confined by business indoors ; the pleasure derived from these forms of exercise no doubt is as great a factor in improved health as the exercise itself.

Rest and recreation are indispensable for every human being. Monotony combined with overwork is doubtless the cause of much mental and nervous disturbance, statistics showing that a high percentage of insanity is among farmers' wives. The isolation and monotony, together with the laborious work, combine to bring mental disaster which might easily be avoided if as much thought was given to the welfare of the mother as is given to the cattle on the farm.

Worry is far more often a cause of mental and physical disorders than mental activity, and as worry is often the outcome of monotony, recreation may be said to be its preventive.

Hard work, mental or physical, is seldom injurious to health when done under favorable conditions; but grinding monotony, with no outside interests, will soon affect the spirit of the individual, which in time injures the general health.

Sleep. — Every human being seems to be a law unto himself regarding the amount of sleep required, although it has long been conceded that eight hours out of the twenty-four is needed by the average adult between 20 and 50. Children and the aged require more, and men can endure loss of sleep better than women, some authorities stating that if a man requires 8 hours a woman requires 9. That many women suffer loss of health from lack of sleep and regularity is evidenced by their speedy recovery when compelled to take the "rest cure." Late, irregular hours and lack of sleep are especially harmful to children, although slothful habits of sleeping twelve hours or more, with the consequent loss of a regular breakfast, are nearly as bad.

Study. — School children should have especial attention paid to the regularity of their hours of sleep, exercise, and diet; if these are all regular, the child seldom suffers from overstudy. If children study at home, they should not be allowed to work with a strong light in their eyes nor to work late at night, neither should they be allowed to get into a state of nervousness over "making a grade."

Mental Attitude. — The mental attitude of the individual is a factor in good health; a busy, cheerful

mind lends great aid to digestion, while a morose, despondent temperament has a reverse effect.

The so-called "mind-cure" is a subject which is widely ridiculed, but it has in its claims some elements of truth which cannot be disputed.

In youth and in fair health the mental attitude is largely under control of the will, and just as the muscles of the body require exercise to attain a high state of development, so the mind and spirit require exercise and control. A child who is taught self-control seldom loses the habit in adult years.

Doubtless the habits of worry and fear undermine the vigor of a very large number of persons who otherwise might be strong and well.

The digestion is easily disturbed by the state of mind; worry, fright, and anger arrest digestion, while cheerfulness promotes it.

Diet. — Moderation in quantity and quality of food is one great factor in preserving health. It is not possible to establish dietaries which are suitable and satisfactory to all persons.

Extreme "fads," either in quantity, quality, or variety, are almost invariably harmful.

Good teeth and thoroughly masticated food are important factors, while good cooking, service, variety, and moderate amounts make up the general rules which should govern one's daily food.

Clothing. — In the selection of proper clothing the comfort of the individual should have more consideration. Women err in this respect more than men, and the discomfort of heavy, constricted garments is productive of much nervous irritability which is wholly unnecessary.

This is especially true in the case of nurses, teachers, and others whose occupation is for a number of consecutive hours which admit of no relief from their uncomfortable clothing. Well-to-do mechanics often afford an excellent example of the suitability and comfort of clothing which is entirely wanting in the case of their wives.

The danger of the transmission of disease germs in clothing and all fabrics, such as bedding, carpets, rugs, and curtains, is well known and should be guarded against.

The clothing of children, particularly school children, is very often unsuitable and unsanitary.

The woolen garments of boys' clothing when worn until filled with dust and much soiled cannot fail to be common carriers of disease. Such clothing should be brushed, sponged, and hung out-of-doors in the sun and wind on Saturdays, Sundays, and holidays. Girls' dresses are usually less dangerous because with small children the garment is often covered with a washable pinafore, and the fabric is not so heavy as the boys' garments. If it were possible to require all school children to wear washable clothing only, many cases of infectious diseases might be avoided.

Shoes and stockings are the most important part of a child's wardrobe. The stockings should be woolen in winter and the shoes low-heeled, with soles heavy enough to protect the feet from any ordinary dampness without rubbers. It is a common sight to see otherwise well-dressed children in thin cotton stockings, with shoes having high heels, pointed toes, and soles so thin that the least moisture on cold pavements must make the feet cold and damp, and probably the child at the same time has the ears and neck muffled with warm, comfort-

able cap and scarf. A good guide is the rule to keep the feet and legs warm and the head cool.

The overdressing of school girls of all ages is deplorable. Fantastically arranged hair, excessive ornamentation, tight, uncomfortable garments, are detrimental to mind and body, and their sequences are found in every hospital in the land.

Excretions. — There are four sources of waste from the human body, viz. the lungs, the skin, the kidneys, and the bowels. All of these organs throw off waste material which is poisonous if retained. In health the work of these organs in excreting waste goes on continually, and we seldom give their activities a thought, and so long as their work is perfectly done we are vigorous and well; but it is necessary for us to do our part, otherwise one or more of these sources of waste will be interrupted in their work and at once we begin to suffer from the poisonous waste retained.

The lungs cannot purify the blood if we supply them with foul air. No one would think of using another person's toothbrush, nor use the same bath water he had used, but many think nothing of breathing air which has been breathed before; they shut their bedroom windows and sleep the whole night without replenishing the air, and wake in the morning feeling dull and heavy, with headache and often nausea; in time they become pale and pasty looking, their eyes are dull, their lips are bluish, and the skin is cracked instead of being red and smooth, their tongues are coated, and they have a bad taste in the mouth; in other words they have deliberately chosen to retain in their bodies a poisonous waste which will surely undermine their health. The

waste from the kidneys is the most disastrous in its effects of any of the waste materials. Few persons drink enough water to flush the kidneys and dilute the waste secreted; 3 pints daily is *an absolute necessity* for an adult. The activity of the kidneys is one of the best preventives of the common catarrhal cold.

The work of the skin and the kidneys is very closely related; if the function of one is disturbed, the other organ undertakes to do double work. Thus in the summer when the skin is active and large amounts of perspiration carry off the waste, the kidneys are less active although unusual quantities of water have been taken; on the contrary in winter when there is little perspiration and much less fluid is taken, the kidneys are very active. The retention of kidney waste speedily causes a long train of disorders and final loss of health. Bathing stimulates the activity of the skin as well as removing the sweat and débris.

The movements of the bowels are regulated largely by the nature of the food taken and by the occupation; but at least one movement daily is a necessity, or there is retained in the system an accumulation of foul waste which is *reabsorbed and is a common cause of many disorders and disease.*

It seems really remarkable that persons of otherwise cleanly habits should be so heedless of this frequent case of filth unspeakable retained in the body, which causes muddy, pimply, greasy complexions, foul breath, dullness of mind, and finally disease.

Use of Narcotics. — The excessive use of alcohol, tobacco, and other narcotics results not only in disaster to the body, but to the mind and moral perception.

In children the effects are seen in retarded physical growth and the stunted mind.

Besides bad and insufficient food as a cause for the craving for stimulation the appalling use of "patent" medicines may be regarded as the chief cause of the drink and drug habits.

It may be safely said that two thirds of all patent medicines contain a greater or less amount of alcohol, opium, or other narcotics. Beginning with the "soothing sirups" given to the baby, it is an almost universal practice to keep all sorts of patent medicines in the household, which are used in such reckless quantities as to frighten any person who understands the danger.

Cough medicines and powders for inhalation are commonly used for colds; probably nearly all patent cough medicines contain opium in some form, while the nasal powders frequently contain cocaine, one of the most dangerous drugs, and one which speedily wrecks the mind if the cocaine habit is established. *Such a practice is all wrong;* not only on account of the danger of an over dose of some unknown drug, but especially because their habitual use cannot fail to create a desire for stimulation which ends in the drink or drug habit.

It should be an unalterable rule in every family that *no drugs of any kind should ever be taken or given except under a doctor's direction;* it is not too much to say that 10,000 persons suffer from the indiscriminate use of drugs to one who suffers from the lack of the right drug given at the right time.

CHAPTER VIII

HOUSEHOLD HYGIENE

In considering household hygiene the subjects of food, water, ventilation, plumbing, sewage and garbage, heating and lighting have already been spoken of in special chapters, as well as personal hygiene.

The practice of hygiene in the household may be said to be good housekeeping, or the observance of such hygienic methods as shall bring all of the foregoing factors into their proper relation to the health of the family.

The House. — The city dweller has little choice in the selection of the site of his habitation, but the country or small town resident has a much wider range, which he often completely ignores.

A house should stand upon well-drained soil, for nothing damp in walls or cellar should be allowed to encourage rheumatism, kidney disorders, tuberculosis, or depressed spirits.

Position. — If possible, a house should stand with its four corners (not sides) to the points of the compass, preferably to face southeast or southwest; in this way the sun may enter the windows of every room.

Sunlight. — In crowded cities where a large proportion of the people must live in small quarters, the absence of sunlight is unavoidable, while in smaller cities, towns, and the country it is inexcusable; but any observant person, taking a railway journey across the continent,

cannot help being appalled at seeing the innumerable number of houses with windows tightly closed, shades drawn down to keep the carpets from fading, and as a crowning offense to health, outside shutters at the windows excluding every ray of light.

It is not too much to say that country people suffer as much from lack of light and ventilation as the dwellers in cities; one might say more, because the majority of city people are being constantly reminded of the danger of close contact and bad air, while in the country the fact that pure air is abundant seems to be thought sufficient, and little effort is made to obtain a supply for indoor use. The dullest woman knows that plants do not thrive without the sun and air, and why so many of them deny their children the same privileges seems hard to understand.

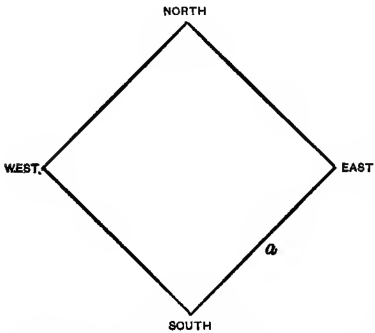


FIG. 24. — Best position for a house. a = the front.

Bedrooms are better for being on the east or south side of the house, where the sun in the earlier part of the day may shine upon open beds.

Closets for clothing, which are without windows should preferably have the doorways screened by washable curtains rather than the solid doors; the curtains may not keep out as much dust, but they admit the air, which is more essential.

Bath rooms and water-closets must have windows or extra large ventilating shafts to be at all sanitary.

Kitchens should be bright and comfortable, as some person or persons must spend most of the day in the kitchen of every household, and a dark, badly ventilated, inconvenient kitchen is depressing to both the cook and the cooking.

Porches should not be too wide nor numerous to shut off the air and light.

Stairs should be broad and easy to mount. There should be no different levels in the rooms; one or two extra steps between rooms, mounted many times daily, soon become very fatiguing.

Ceilings had better be high than low, for while more difficult to heat in winter, the rooms are cooler in summer, and the supply of air at all seasons is more nearly adequate. The **amount of room** in a house must necessarily be governed by the family income rather than by the number in the family.

The practice of utilizing porches for sleeping or dining rooms is an excellent one and cannot fail to produce good results; tents also are a practical, inexpensive means of enlarging household space for seven or eight months of the year, or even longer in the milder climates. Porches on the south or east side of the house may be shut in with canvas for the winter months and wire fly netting the rest of the year, and used for sleeping practically the whole year.

Furniture.— Too much stress cannot be laid upon simplicity in furnishing. Elaborate decoration, upholstered furniture, heavy portières, and quantities of bric-a-brac require extraordinary care to keep clean, the kind of care

which is beyond the means of the majority of households, and it is in the household of moderate means where there is neither time nor servants to clean them that such elaborate furnishings are a constant menace to the family health.

Woodwork. — The finishing woodwork of a house is frequently full of fancy scrolls, panels, and beveled surfaces, which are almost impossible to keep free from dust; whereas perfectly plain surfaces and edges would not only be more sanitary, but much more pleasing to the eye of any person whose tastes were not of the junk-shop order.

Wall Paper. — Dull, dark wall papers and rugs "which do not show the dirt" are depressing; Nature is constantly teaching the need and beauty of bright colors. When wall paper is renewed, the old paper should always be removed.

Floors should either be of hard wood with polished surfaces, or painted, that they may be easily cleaned. Rugs and carpets should not entirely cover the floors nor should they be nailed down, but left that they may be frequently taken up and out-of-doors for cleaning and airing. Sweeping with a broom is strongly condemned, but it seems a question as to which is more dangerous to health, sweeping with a broom occasionally with all windows and doors wide open, or using a carpet sweeper or other hair brush which leaves much dust in the fabric and which is raised in clouds whenever walked over. In many households it is impossible to have rugs and carpets beaten and aired more than four or five times a year; consequently where there are children, rugs and carpets soon become very dusty.

Damp sawdust scattered over a bare floor before sweeping will gather most of the dust and prevent its floating in the air ; it is used largely in well-regulated hospitals and should always be used in the sick room. When sawdust cannot be obtained, damp paper torn into small pieces may be substituted, although not as effectual in gathering dust as the sawdust, it is far better than nothing, and may be used upon carpets and rugs as well.

The danger to health from floating dust cannot be too strongly emphasized and every possible means should be taken to prevent its accumulation. Feather dusters should be forbidden by law, dusting *should always be done with a soft, clean cloth, slightly dampened*, the dust being wiped off on the cloth, not scattered in the air. The cloth duster should be kept clean by frequent washing, and while dusting a room should be taken out-of-doors two or three times to shake out the dust.

In a sick room in case of a contagious disease the dusters should be tightly rolled in a bit of newspaper and burned every day as soon as the dusting is finished ; in this way the dust which may be filled with disease germs is no longer a source of danger to others. The sawdust used for sweeping the floor of the sick room should also be rolled in paper and burned at once.

Clothing. — The care of body and bed clothing is one of the most important as well as difficult problems of domestic hygiene; the expense of laundry work or the hard labor required to do it forms certainly a good excuse for economizing, but such economy is doubtless a far more frequent cause of disease than is realized.

In the state of Wisconsin a law was recently enacted which requires that all hotels, boarding houses, and

sleeping cars shall supply sheets long enough to fold under and over all sides of the bed at least eighteen inches; this law has been the object of great ridicule from the ignorant, who would have no objection to coming in contact with bed covers and mattresses suffering from long-continued use by others ; but to any intelligent person such a law is a long step in a sanitary direction, the only regret being that it could not be enforced in every household, school, and hospital in the land, for clean beds are quite as essential for health as clean food.

The custom of collecting soiled clothing in bags or hampers in bedrooms should be abolished; receptacles for soiled clothing may be kept in the bath room, provided it has a window or the family is not too large, but a back gallery, porch, or hall had much better be used than the bedrooms.

Every person in a household should be provided with individual towels and wash cloths quite as much as toothbrushes.

Body linen should be changed at least twice a week, oftener in warm weather.

Children's towels, wash clothes, and handkerchiefs must be abundant.

The testimony of many school teachers is, that most children are poorly supplied with clean handkerchiefs, which no doubt contributes largely to the epidemics of influenza and colds.

Dish Towels. — The use of unclean dishcloths and towels should be strongly condemned ; dishcloths foul with grease and dirty water are often put away without any cleansing and used over and over, while a household where such a condition prevails is nearly always pervaded

with house flies, which are attracted by filth, and are a constant source of danger to a whole neighborhood.

Ice boxes, cupboards, and cellars where food is stored should be kept scrupulously clean. House cellars should not be used for storing large quantities of fruit and vegetables in winter. In hot weather all food decomposes rapidly, and constant vigilance is needed to avoid the extravagance of destroying large amounts, or using food which is in the process of decay.

Disinfectants. — Too many housekeepers gain a superficial and dangerous smattering of knowledge about disinfectants, and lose sight of the fundamental principle of plain everyday soap-and-water and sunlight disinfection; the writer once saw in the house of a wealthy, educated woman a two-ounce bottle of carbolic acid without a cork, suspended by a string on a nail directly over a slop hopper, and was told it was *to disinfect the hopper;* what the slop hopper really needed was hot soapsuds and a brush vigorously applied.

The general rule for the use of disinfectants in the household should be the same as in the hospital or laboratory, viz. that *the quantity used should be equal to or exceed the matter to be disinfected;* thus the foul slop hopper would need at least two gallons of boiling hot soapsuds, to which might be added a handful of washing soda, a vigorous scouring with a long-handled sanitary brush, and then if followed by one or two gallons, not ounces, of 5 per cent carbolic acid we might reasonably say it had been disinfected.

Protection from Insects and Vermin. — Since diseases such as malaria, typhoid fever, cholera, and tuberculosis are known to be carried by insects and vermin, a house

should be provided with wire-netting screens at every window and door, from early spring until after the first heavy autumn frosts, usually late in October. It is essential to retain the screens late, as house flies seem to take a new lease of life when warm days recur, and while in that condition frequently drop dead in milk, water, or food which is not protected.

Screened doors should be provided with springs, that they may never be left standing open.

Two kinds of so-called fly paper for the destruction of flies is in common use, one which is poisonous and another covered with a thick, mucilaginous substance, which entraps the fly.

Poison fly paper is particularly dangerous when there are young children in a household, and also the poisoned insect often finds its way into dishes or food. Cleanliness and screens are the best preventives of house flies.

Sloth and filth are usually accompanied by bedbugs. If these are permitted to multiply and a house becomes infested, it is a labor of weeks and months to get rid of them. Fumigation with sulphur, repeated at intervals of a day or two for a fortnight, is efficacious if followed by thorough house cleaning in every crack and crevice of the rooms and kept up for weeks.

Rats and mice often overrun houses and other buildings, and at times are very difficult to get rid of.

Traps will usually dispose of mice, but rats are very wary of traps, and poison is dangerous to have about, besides the danger of the animals dying in wall spaces or under floors.

Cats seem to be the only solution where rats become very numerous, not one cat but several put into base-

ment, cellar, garret, and outhouses. Some persons regard the cats as great an affliction as the rats, but once the rats are exterminated, one good cat will usually protect a house, while rats are destructive and dangerous, as they run in and out of sewers, drains, barnyards, into every imaginable kind of filth, which may be carried on their feet to all parts of a dwelling.

Cellar and basement windows and doors should be kept screened throughout the entire year as a protection from rats and mice.

The details of hygienic housekeeping are too extended to be cited in a book of this kind, but the statement made by Harrington that "housekeeping is too often spread with an uneven hand" cannot be denied.

The hardships of housekeeping which fall to the lot of so many women, arise largely from their ignorance of the simplest rules of hygiene.

CHAPTER IX

SCHOOL HYGIENE

SECTION I

THE majority of school children spend from ten to twenty-five hours weekly in the schoolroom, for a period of several months each year, for eight or ten years of their lives; such being the case, the need of hygienic school buildings and for good personal hygiene must be admitted.

School hygiene "concerns the parent, the physician, and the citizen, and its investigations must consider the personal hygiene of the scholar, the conditions of his health, his habits, the amount of work done, the sanitary environment and requirements of the schoolroom and building, the furniture, the ventilation and heating, and the influence of all these upon the individual's state and development."[1]

Site. — It is of no less importance for the school to be built upon well-drained soil than for the habitation; this is necessary not only to insure the walls and basements against dampness and to secure good drainage for sewage, but to provide playgrounds which do not permit standing water.

Structure. — All school buildings should be detached to secure the maximum amount of light and air. Double walls with an air space prevent dampness and secure

[1] *Hygiene and Sanitation,* Egbert.

warmth for any building; stone walls are usually damp, while double brick walls with the air space are perfectly dry.

The height of the first story of the building, as well as the window space, should be greater than for the upper stories, to secure the proper amount of light and ventilation.

The windows should be higher from the floor than in a dwelling, and should extend to the ceiling, with proper shades for excluding the direct rays of the sun when necessary.

Lighting. — The proper lighting of schools is of great importance to every child.

The light should be sufficient and come from the child's left side and back; he should never sit facing the light.

Light falling from the right side throws a shadow of the hand when writing or drawing, while light from the front is a constant source of irritation to the eye, and causes squinting and headaches.

Insufficient light is said to be a frequent cause of myopia (near-sightedness) in children.

Cohen maintains that "a schoolroom cannot have too much light" and recommends that for every square foot of floor space there should be a square foot of window glass.

The best authorities recommend that schoolrooms should be oblong, with windows placed in one of the long sides, and seats running parallel to the short side, the light falling from the left side of the pupil.

Blackboards. — The blackboards should never be placed on the same side of the schoolroom as the windows, as the light in the eyes causes an unnecessary

strain; neither should the blackboards have glazed, shiny surfaces, for the same reason.

The distance of the blackboard from the farthest seats should cause an inquiry regarding the sight of pupils who occupy them. Copying from the blackboard requires rapid changes in accommodation (adjustment of the eye to different distances), which is regarded as an important factor in producing defective sight.

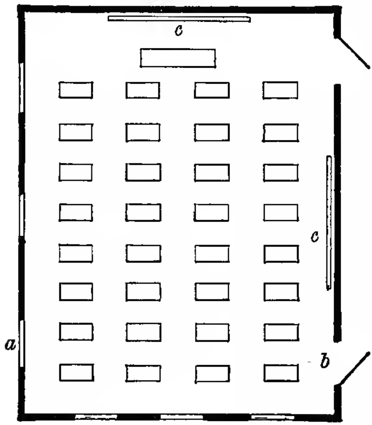


Fig. 25. — Schoolroom: *a*, windows; *b*, doors; *c*, blackboards.

Corridors and Cloak-rooms. — Corridors should be wide and straight both as an assistance in time of fire or other panic and to aid ventilation.

Stairways should be broad and easy to mount, preferably with a landing midway and ending near the door of exit, stairways being placed at both ends of a building.

Wardrobes in the more modern schools are made with individual lockers to avoid contact of clothing. When the corridors are wide enough, such wardrobes are placed in them, but in narrow halls this could not be permitted. The especial objection to the wraps being placed in the basement, as is commonly done, is because of the lack of air and light.

In small country schools where the entrance hall is

commonly used for wraps, the nearness to the outside door and abundance of light and good air makes a better arrangement scarcely necessary.

Heating and Ventilation. — In large schools like other large buildings the heating and ventilation must necessarily be considered together, the best method probably being the indirect method, whereby the air for ventilation is heated to the required temperature and propelled by fans into the rooms. By this method the air may be filtered and the temperature automatically controlled by a thermostat.

The heating of country schools by stoves in cold climates is as unsatisfactory a method as can possibly be imagined. The floors are always cold, and country children suffer cruelly from chilblains and colds; while the upper part of the room is too warm, the outer rows of seats are in an icy atmosphere, and the whole room suffers from bad air.

Sewage, Water-closets, Wash-rooms. — The plumbing of a school building like that of a house should be of the best character, with no hidden pipes and joints, well trapped, and an abundant water supply for flushing.

Water-closets and wash-rooms should have air and light in abundance and be built with tile or concrete floors and walls. In the primary rooms the seats of water-closets should be low to suit the child, likewise the washbowls, the latter being supplied with soap and an abundance of small towels. The cost to the community of supplying clean towels for the wash-rooms is a trifle in comparison to the expense of epidemics.

The filth and foul air of the toilet rooms of many schools in decent communities is unspeakable, and aside

from the danger of contagion from washbowls, dirty towels, and closet seats, the moral effect is quite as bad.

Every toilet room in all schools should have an attendant on duty from the time the building is opened in the morning until the last pupil has gone in the afternoon. It is impossible for teachers or janitors to oversee the toilet rooms.

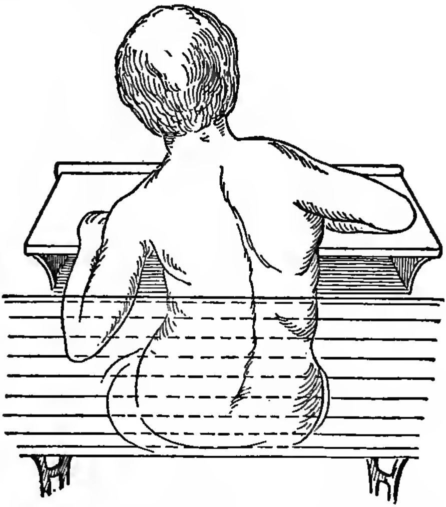


FIG. 26. — Position assumed in writing with the desk too high.

Sweeping and Dusting. — Schoolrooms and corridors should be swept daily with damp sawdust, and all desks, seats, tables, and window ledges be wiped with damp cloth dusters. *Dry sweeping and dusting should be forbidden.* Toilet rooms should be scrubbed daily.

Seats and Desks. — Improperly constructed seats and desks by compelling a child to assume a cramped or strained position produce curvature of the spine.

Schoolrooms should not be provided with fixed seats and desks of uniform size according to the grade. In this respect the country schoolroom has the advantage over many town and city schools, as the seats are usually of three or four sizes and children are placed according to their size and not their grade.

Lincoln makes the following suggestions regarding seats and desks: —

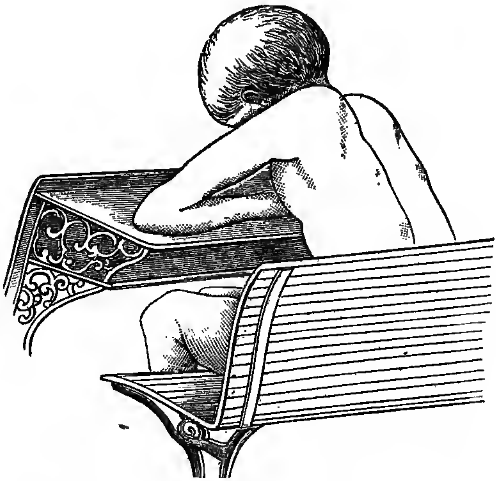


Fig. 27. — Position assumed in writing with the desk too low.

"1. The chair is often too high for young scholars. The most convenient plan may be to provide footstools. 2. The seat from back to front ought to be long enough to support the whole thigh. A more or less spoon-shaped hollow in the seat is commonly thought desirable. The curve of many settees is such as to produce pain at the point where the tuberosities of the ischium rest on the

wood; the support is there not wide enough. 3. Seats must have backs. The straight, upright back reaching to the shoulders is bad; a straight back, slightly tilted, is not bad. American seats are commonly curved, with curved backs. 4. The edge of the desk should come up to or overlap the edge of the seat. The recognition of this fact is a recent discovery. 5. Most of our best desks are too high relatively to the seat, doubtless to prevent the pupil from stooping. Something is gained in convenience of reading by this plan, but it interferes with correct positions in writing. The elbows, hanging freely, should be only just below the level of the lid. For near-sighted children the higher desk may be a necessity in writing; if the desk is made low, a portable writing stand may be placed on top of it when necessary."

Fig. 28. — Desk too low.

Fig. 29. — Slipping down in seat.

Fig. 30. — Correct position.

Drinking-water. — The dangers from drinking-water are twofold: from an impure water, and from drinking-cups. Except in the case of very small children all

school children should early be taught the dangers of a common drinking-cup. The custom of providing each child with his own cup is right theoretically, but inquiry reveals the fact that many cups go unwashed for the whole school year and may easily carry typhoid fever, tuberculosis, diphtheria germs, or worse infections.

Provision should be made for the individual drinking-cups to be washed and boiled daily, or automatic drinking-fountains should be provided.

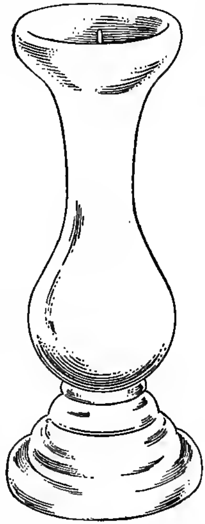


FIG. 31. — Wolff's porcelain sanitary drinking-fountain.

Common Defects. — Lack of cleanliness is the most glaring and universal defect of schools, the country school being quite as bad as the school in the city.

Dust covers floors, walls, and furnishings, while water-closets and basins are unclean, and the atmosphere is tainted with the emanations from unwashed bodies, soiled clothing, defective plumbing, and coal gas.

The schoolroom floors in most buildings are scrubbed *once a year*, and were it not for the vacation interim it is doubtful if many pupils would escape serious illness.

In the older public school buildings of several large cities, many have only two or three rooms which have sunlight, while toilet rooms and cloakrooms are in the basements without a ray of daylight, and the entire buildings tainted with the foul air arising from them.

If it were possible to build schools with the same sanitary precautions that enter into modern hospitals, much disease might be prevented.

Concrete floors, and stairs with rounded angles, perfectly plain woodwork and furniture, sunlight in every room, and good plumbing would make a vast difference in the health record of schools. With concrete floors provided with drains, the floors might be washed or flooded daily and do away with the suffocating dust arising from unwashed wood floors, and chalk, which cannot fail to be a carrier of infectious materials.

In country schools lack of cleanliness is less harmful on account of the abundance of pure air and sunshine, but the cold floors, improper lighting, and absence of all toilet conveniences make them extremely uncomfortable and often unsanitary.

Luncheons. — The subject of luncheons for school children is an important one to the city and country pupil; in small cities and towns the majority of children go home for their noon meal, which is a great advantage.

The luncheons of country children from comfortable homes are better, from a hygienic standpoint, than the almost universal custom of large cities, where children buy what suits their fancy from any convenient bakery or lunch room.

For fifteen years the writer daily passed a lunch room near a large public school in a well-to-do neighborhood, and feels safe in saying that fully two thirds of these children, between twelve and eighteen years of age, made their noon meal upon a cup of coffee and a piece of pie or cake, with ice-cream as a luxury.

The unappetizing medley of food jumbled into a lunch box, which commonly passes for the school lunch, is so altogether unpleasant that the child cannot be blamed for particularly objecting to it; but there is no necessity for a lunch box being monotonous or unappetizing.

An infinite variety of sandwiches made of bread and meat, or eggs, or cheese, or jam, are easily prepared, and when neatly put together and each sandwich rolled in the paraffin paper which may be bought at any grocer's, they are not unsightly nor flavored with the other articles of food; simple cakes or cookies, fruit, and a few pieces of pure candy make a good variety, and an occasional turnover or individual pie is always the treat.

A common mistake is in providing too much. The prevailing habit of overeating doubtless originates in the almost universal practice of giving small children something to eat to keep them quiet. Children, like adults, who eat too much, are heavy and inert, with little relish for study.

The diseases and disorders common to school children arise very largely from contact, — especially the infectious diseases, scarlet fever, diphtheria, measles, chicken pox, and mumps, — the common cloakroom being the important place of contact, as coats and wraps hang together for several hours.

Defective sight may be caused by improper lighting or badly constructed seats and desks. Copying from the blackboard should not be a routine practice, as before mentioned; the rapidity of changes in accommodation produces eye strain and its consequent headaches.

Disordered digestion is very common with school children, caused by nervousness when the child strives to make grades or is worried over examinations, or from lack of exercise or improper food.

An investigation among the tenement children of large cities revealed the fact that many puny children came to school without any breakfast, and some with no lunch, their only meal being at night, when the father and mother returned from work; these children nearly all suffered from indigestion.

Underfeeding is not confined to the tenement children. The child subsisting upon coffee and bakery pie stands quite as good a chance of contracting curvature of the spine as the child with no breakfast.

Headaches arise from indigestion and bad air as well as lack of exercise and eye strain.

Curvature of the spine is said to be caused by wrong positions in seats or at desks; but with healthy, vigorous children it seldom occurs, the impaired vitality of underfed and overworked children being a greater factor than improper seats and desks.

The nervous strain of overwork in school is more noticeable in girls than boys. Girls after the age of twelve need special supervision over their diet, exercise, clothing, hours of sleep, and recreation. Girls usually are required to spend more time out of school upon music or other accomplishments, and they suffer from the restriction of their recreations. Again, with the poorer classes, many young girls are required to do several hours of laborious housework morning and evening, while boys who are required to work usually find employment out-of-doors, which is far more wholesome.

Children suffering with chorea and epilepsy should not attend school with other children; the excitement and school routine and conditions aggravate both maladies, and the effect of their evident disorders upon other nervous children is serious.

Growths or obstructions in the nose or throat are very common. R. H. Johnston "regards the real nature of mental and nervous troubles in these cases as toxic from a deficiency of oxygen in the inspired air. The list of symptoms produced includes mental dullness, restlessness, night terrors, nocturnal incontinence, headaches, stuttering, and various other defects of speech, choreic movements of face, etc. Mention is made of reflex nervous cough, irritability of disposition, etc."

The tendency of parents to put the onus of impaired health upon the strain of overwork in school is often unjust; a child who is well fed, clothed, and sheltered in clean surroundings, with sufficient sleep and exercise, very seldom suffers from too much study.

Dangerous Habits among Small School Children. — Two dangerous practices have been largely done away with in city and town schools, although unhappily still to be found in many rural schools; these are the use of common drinking-cups and the use of slates with saliva as a means of erasure.

It seems to be instinctive with small children to put things into their mouths, including their own fingers. Three of the most common contagious diseases, diphtheria, tuberculosis, and typhoid fever, are in most instances contracted from what goes into the mouth, hence the grave dangers from unclean hands and finger nails, soiled handkerchiefs, common drinking-cups, and

wetting the finger in the mouth to clear the slate. Many school children are not free from chapped hands and lips from October to May. Every abrasion of the skin and mucous membranes is an avenue for the entrance of infection and thus a constant menace to their health.

If a child's hands are thoroughly washed in warm water and plenty of good soap, rinsed in clear water, well dried, and anointed with some cold cream at bedtime every night, the cracked and often bleeding dirty knuckles would not be seen even in the snowball season. Soiled gloves and mittens often cause roughness and chapping of the skin.

Kissing among school children should be forbidden by both the rules of the school and the home. Likewise, putting pens and pencils into the mouth, biting finger nails, the exchange of hats and wraps, and two or more children biting into the same article of food as is so often done with candy or fruit. All of these things seem trivial in themselves, but are in reality sources of grave danger as well as offenses against everyday cleanliness. It is not to be expected that teachers must correct all habits of uncleanliness, but by example and a little precept they may be a tremendous force in the preservation of the health of the pupils.

CHAPTER X

HYGIENE OF OCCUPATION

Section I

It has long been the opinion of medical authorities that occupation is an important factor in health and disease, but the best authorities differ in their estimate of the value of the statistics of various occupations.

While not disputing that many occupations cause or are a predisposing factor in causing disease, the wide difference in age, heredity, habits, and surroundings of individual workmen makes such statistics misleading.

Many occupations, such as the army, navy, factories, and railways, are dangerous to life, but not necessarily to health.

Tuberculosis is common among dressmakers, tailors, cutlery grinders, and the factory workers of cotton and woolen mills. The disease germs, however, are not found in the lint nor dust ; but the conditions incident to overcrowding, bad air, and inhalation of dust lower the vitality and irritate the lungs, making them fruitful soil for infection. If all of these occupations could be carried on out-of-doors, the high death rate from tuberculosis would be speedily lowered.

Low wages may be considered one of the most important indirect causes of loss of health in the working classes.

Poverty means overcrowding, filth, bad air, and insufficient food and clothing, all of which cannot be offset by sanitary occupation. Low wages also compel child labor and the woman of the family doing double duty, in housework and wage earning, two evils whose bad effects are felt by succeeding generations.

Location of occupation often makes the work sanitary or the reverse; a factory situated in the country or a small town with an abundance of sunlight and good air and the same factory situated in a crowded city, the workmen breathing foul air, soot, and dust, and working by artificial light, cannot be judged in the same way. Fortunately for the good of the nation, employers, legislators, and sanitarians are making a combined effort to improve the sanitary conditions surrounding all classes of workers.

In many states laws governing the air space, ventilation, lighting, heating, hours of labor, and employment of women and children in manufacturing industries have done wonders in improving the condition of the laboring classes.

In classifying the occupations from the standpoint of hygiene they may be divided into "(1) Those which are dangerous to health from the materials used; (2) Those which in themselves are harmless but are carried on under unsanitary conditions; (3) Those involving danger of injury; (4) Those which are dangerous neither to health nor life." [1]

[1] Harrington's divisions.

1. *Those Occupations which are Dangerous to Health from the Materials Used*

Irritating gases:

Ammonia.

Chlorine, from brick glazing and bleaching powder, causes catarrh, loss of sense of smell, bronchitis, asthma, and decay of teeth.

Hydrochloric acid, from alkali works and galvanizing iron, has the same effect as chlorine to a lesser degree.

Sulphur dioxide, from smelting and match works and in the manufacture of sulphuric acid, has no very serious effects and disturbs the digestion more than the breathing.

Nitrous fumes, from contact of nitric acid and metals, said to cause phthisis.

Poisonous gases and fumes:

Carbon monoxide, from many manufacturing operations, causes disturbances of the digestion and weakness both mental and physical.

Carbon disulphide, used to dissolve fats and in rubber works, causes headache, disordered vision, dizziness, and convulsions in the rubber workers; usually no permanent injury results.

Naphtha, used for garment cleaning, produces vomiting, headache, dizziness, and hysteria, symptoms sometimes persisting for several weeks.

Mercury, used in the manufacture of mirrors, thermometers, barometers, electric batteries, and felting, produces the usual symptoms of mercurial poisoning, fetid breath, soreness of teeth, and

later a dark line at their upper margin, salivation.

Phosphorus, used in the manufacture of matches, may cause necrosis (decay) of jaw; occurs less frequently than formerly, owing to improved machinery.

Arsenic, from smelting operations. The fumes of arsenic are less dangerous than dust containing arsenic.

Brass, in brass founding, produces "brass founder's ague."

Wood alcohol fumes sometimes arising from varnish may cause temporary blindness.

Offensive gases and vapors arising from soap making, tanning, glue making, fertilizer making, bone boiling, and other offensive industries, have not been found injurious to workmen, nor to those persons living in the vicinity. New workmen often suffer from headache, nausea, and loss of appetite, but the symptoms soon disappear.

Poisonous dusts:

Arsenic, used in printing wall paper, cretonnes, artificial flowers (especially hazardous), and green glazed paper for box covers, causes eczema and ulcers, nausea with metallic taste, pain or soreness in abdomen, itching of eyelids, symptoms increasing.

Lead, one of the most common and disastrous of the industrial poisons, is taken both by inhalation and carried into the mouth by soiled fingers. Used in paper glazing, artificial flowers, painting, plumbing, printing, enameling, and in making

china and other pottery. Causes paralysis of muscles of forearm called "wrist-drop," pallor, thirst, loss of appetite, fetid breath, emaciation, colic, and rheumatic pains. Frequently results in death. More women in proportion than men workers suffer from lead poisoning.

Irritating dusts:

Metallic dust, from glass and steel grinding, gem polishing, stone work, mica dust. Pneumonia and phthisis are common among the workmen.

Vegetable dusts, from cotton and linen, are especially irritating and the workers generally unhealthy, phthisis being common. Carpenters do not suffer from wood dust, as they work out of doors, while cabinet workers indoors are subject to phthisis. Millers do not seem to suffer from grain dust. Tobacco dust causes nasal and bronchial catarrh with disturbances of digestion and nervous system.

Animal dusts, from wool, silk, fur, bristles, horn, ivory, bone, and hair are all more or less irritating. Wool is said to be less so than cotton or linen, while bone, ivory, and horn have the same effects as the metallic dusts.

Infective matter in dust, from rags, hides, wool, and horsehair. Especially dangerous from anthrax (wool-sorters' disease) when workmen have any cuts or abrasions upon the hands, and from cholera, scarlet fever, yellow fever, smallpox, and other infectious diseases.

Exposure to heat, such as in the work of cooks, bakers, engineers, firemen, miners, workmen in

rolling mills, glass factories, and many others, causes exhaustion. The sudden chilling of the body provokes catarrh, rheumatism, kidney and skin diseases, among these workmen.

Exposure to dampness indoors is detrimental to health, while workers out of doors, such as fishermen, sailors, and drivers, are usually healthy and long-lived.

Atmospheric Pressure. — Tunnel and bridge builders who work in caissons under water have a disease known as "caisson disease."

Restricted attitude in many trades causes deformities and is often a factor in causing phthisis.

2. *Those Occupations which in themselves are Harmless but are carried on under Unsanitary Conditions*

To this class belongs all indoor work carried on under such bad conditions as overcrowding, lack of light and air, and uncleanliness. The work of a clerk in a shoe shop would hardly be considered a menace to health, but if the shop be in the basement of a department store, where low ceilings, overheating, artificial lighting, and overcrowding are continually present, the clerk would no doubt became pale, languid, and dull, besides having little resistance to any disease, and it is this loss of resistance which renders this class of workers so liable to all diseases. Sewing could not be called an unhealthy occupation, but the dressmakers, tailors, and sweat-shop workers who toil in crowded dark rooms are frequent victims of tuberculosis.

The list of such occupations might be carried on almost indefinitely and the conclusions be the same, viz.

that it is not the work, but the conditions surrounding the worker both in the shop and home, the latter often as unsanitary as the former, which result in anæmia, dyspepsia, depressed spirits, and loss of resistance to all diseases.

3. *Occupations involving Danger of Injury*

Miners, factory workers of all kinds, machinists, and railway employees are exposed to greater danger to life and limb than in other occupations. So enormous has become the loss of life and crippling of workmen in this country that a general awakening to the need of better protection for laborers is taking place.

Two exhibitions have been held, one in Philadelphia and one in Chicago, showing the dangerous conditions under which men, women, and children are employed, together with a large number of safety devices for their protection. The great number of accidents occurring upon all railways includes passengers as well as employees, and the better protection given to both passengers and workmen in European countries may be readily seen in the following statistics: in 1907, 647 persons were killed by railway accidents in the United States, 18 in France, 74 in Germany, and 119 in Great Britain. In the case of workmen killed, the majority are comparatively young, vigorous men, leaving young families unprovided for, which are in turn left to struggle with poverty and all of its necessary deprivations.

Doubtless another decade will see the enactment of many protective laws for this class of workmen.

4. *Occupations which are Dangerous neither to Life nor Health*

This class of occupation is too extended and two well known for enumeration here. Persons engaged in sedentary work frequently suffer from indigestion, insomnia, nervousness, and debility, but these are caused by lack of physical exercise to a great degree, and cannot be attributed to the occupation. The nervous and mental disturbances are usually from monotony.

Farmers' wives and many other women whose housework keeps them in a monotonous routine for years at a time are frequent victims of mental and nervous disorders. In these cases there is no lack of physical exercise; on the contrary, too much; but there is lack of fresh air and often lack of proper food, as they are too exhausted to prepare food, or to eat if it is prepared, while many of them are deprived of any leisure or diversion.

Section II

The Employment of Women and Children. — The most serious problem of industrial hygiene is that of the employment of women and children. The consequences of long hours, confinement, and unsanitary conditions are far-reaching, the effects being seen in the second and third generations. It is within a hundred years that the first laws were enacted for the protection of women and children. That a law was necessary to restrict the working hours of children to *twelve* hours a day seems too monstrous to be possible, but little boys have worked that many hours *at night* in the glass factories of certain

states in this country within the last two years (1907–1909) and at the present writing (January, 1909) the struggle to secure federal laws regulating child-labor is still pending.

The United States census of 1900 reports 500,000 children between the ages of ten and fourteen years who could neither read nor write, and were mostly employed in the cotton fields and mills of the South. Medical statistics upon the results of child-labor are extremely meager, although it does not require any great amount of intelligence to fully understand how disastrous to physical, mental, and moral health such work must be. Like many other questions, the cruelty and immorality does not appeal to men, and adequate protection will never be given in all states until the harm from an economic standpoint is forced upon the nation. In another generation, when the country has need of every possible able-bodied man for workmen and soldiers, there will be an awakening to the evil effects of child-labor.[1]

The brief for the defendant, in case No. 107 of the Supreme Court of the United States, October, 1907, cites the testimony of many eminent authorities upon the necessity of restricting the hours of labor for women, also giving an account of the legislation enacted in many foreign countries as well as in our own states, from which the following is quoted: —

[1] References: Proceedings of the National Child Labor Committee. Report by the Commission on Industrial and Technical Education in Massachusetts. *School or Work?* issued by the Consumers League, Chicago. Report of the case, Curt Miller *v.* State of Oregon, Supreme Court of the United States, October Term, 1907, No. 107. *The Woman Who Toils,* by Mrs. John Van Vorst and Miss Marie Van Vorst.

"The British law of 1844 was the first statute in any country limiting the hours of labor for adult women. It simply extended to women the provisions of the Act of 1833, which had restricted the work of children in textile mills to twelve hours per day. In 1847 the legal working time for women as well as children in textile mills was reduced to ten hours per day. By further legislation in 1867, 1878, 1891, and 1901 further restrictions were introduced."

France, Switzerland, Austria, Holland, Italy, and Germany, all have laws restricting the hours, thirteen hours being the maximum granted and that only for "overtime" in special seasons, for not more than two weeks at one time, nor for more than forty days in one year.

In the United States, "twenty States of the Union, including nearly all of those in which women are largely employed in factory or similar work, have found it necessary to take action for the protection of their health and safety and the public welfare, and have enacted laws limiting the hours of labor for adult women.

"This legislation has not been the result of sudden impulse or passing humor, — it has followed deliberate consideration, and been adopted in the face of much opposition. More than a generation has elapsed between the earliest and the latest of these acts.

"In no instance has any such law been repealed. Nearly every amendment in any law has been in the line of strengthening the law or further reducing the working time.

"The earliest statute in the United States which undertook to limit the hours of labor for women in

mechanical or manufacturing establishments was Wisconsin Statute, 1867, ch. 83, which fixed the hours of labor as eight. The act, however, provided a penalty only in case of compelling a woman to work longer hours.

"The earliest act which effectively restricted the hours of labor for women was Massachusetts Statute, 1874, ch. 34, which fixed the limit at ten hours. The passage of the Massachusetts Act was preceded by prolonged agitation and repeated official investigations. The first legislative inquiry was made as early as 1865.

"In the United States, as in foreign countries, there has been a general movement to strengthen and to extend the operation of these laws."

. . . .

". . . Physicians are agreed that women are fundamentally weaker than men in all that makes for endurance: in muscular strength, in nervous energy, in the powers of persistent attention and application. Overwork, therefore, which strains endurance to the utmost, is more disastrous to the health of women than of men, and entails upon them more lasting injury."

President Roosevelt's Annual Message delivered to Second Session of 59th Congress. December 4, 1906

"More and more our people are growing to recognize the fact that the questions which are not merely of industrial but of social importance outweigh all others; and these two questions (labor of women and children) most emphatically come in the category of those which affect in the most far-reaching way the home life of the Nation."

CHAPTER XI

DISINFECTION, QUARANTINE

Contagion. — In the transmissible diseases substances which carry disease germs are thrown off from the body, and under favorable conditions these germs will be reproduced: such as the sputum in pulmonary tuberculosis; the discharges from the mouth, nose, and throat in diphtheria; the peeling skin (desquamation) in scarlet fever and other eruptive diseases, and the discharges from suppurating wounds.

Knowing that disease germs may be present in all the excreta from the body of a person with a contagious disease, and that darkness, filth, heat, and moisture favor their reproduction, it remains for all concerned to combat the conditions which are favorable to their development.

Perfect cleanliness of person, bedding, utensils, floors, walls, and furniture in the sick room, with good ventilation and sunlight, must be the foundation for the prevention of contagion, for without them the complete destruction of the germs, which we call disinfection, cannot take place.

Besides the sanitary measures taken for the prevention of disease, certain agents are employed for the destruction of the bacteria of specific diseases, to limit the spreading of infectious diseases. These agents are known as disinfectants and antiseptics.

Disinfectants are divided into three classes: light, heat, and chemicals.

Light. — The direct rays of the sun are powerfully disinfectant; sunlight destroys or retards the growth of many disease organisms, while diffused daylight and electric light are much less effective. The bacilli of tuberculosis have been destroyed by direct sunlight in from a few minutes to a few hours; typhoid fever bacilli, anthrax spores, and cholera bacilli are also destroyed by sunlight.

This germicidal effect of sunlight should be appreciated in the location of houses and the arrangement of windows, as well as in the care of the house, which should daily utilize the sunlight to render the habitation wholesome.

The exposure of bed clothing to the sun and air is rarely done in many households; blankets and mattresses are used for weeks and months at a time without a ray of sunlight touching them; and when rugs, draperies, upholstered furniture, cushions, etc., are added to the bedding, the wonder is, not that epidemics prevail, but that they ever cease.

Sunlight has a sterilizing effect on the bacteria contained in drinking-water and sewage. The practical use of sunlight must necessarily be mostly in the prevention of disease, as it is not available at all times nor in all places; it might, however, be used much more in disinfecting furniture after infectious diseases, especially in small towns or the country, where it is feasible to expose the furnishings of an entire house to the rays of the sun. For generations it has been a country custom to expose all utensils used for milk to the rays of the sun. The originators of the practice were doubtless ignorant of the principle involved, but

their observation taught them the advantages to be derived.

Heat. — Disinfection by means of dry or moist heat is often employed. Dry heat is less effective than moist heat, besides being destructive to many fabrics. Moist heat in the form of steam under pressure or boiling water may be used much more effectively and practically than dry heat. The first known practical application of steam for disinfection was that made by Dr. A. N. Bell of the United States Navy, upon two ships infected with yellow fever during the Mexican War in 1848, but during the past twenty years a large number of steam sterilizers, both portable and stationary, have been devised for the disinfection of all kinds of water, clothing, bedding, carpets, surgical intruments, utensils, suture material and dressings, and the mails. Many cities and towns are provided with sterilizers for public use, while all hospitals are equipped with several for use in the different departments.

The process of doing the household laundry work is an almost complete sterilization by heat. The clothing is first soaked in cold water, washed in hot soapsuds, boiled for fifteen minutes, rinsed in clear water, dried in the sun, and ironed with a hot iron, which is a cycle of disinfection not to be despised by the scientist and for which our ancestresses who devised it have had little credit.

Boiling Water. — Many articles such as surgical instruments, dishes, and washable clothing, except woolens, may be easily disinfected by boiling for half an hour.

Cold is an antiseptic but not a disinfectant, the difference being that an antiseptic limits or retards the

growth of bacteria but does not always kill them, while a disinfectant destroys them completely.

The typhoid bacillus, it is said, will survive 100 days of freezing, and cholera germs also will withstand several days of freezing, while an instance is recorded of diphtheria bacilli being frozen for four months, with the survival of a few.

Chemical Disinfectants. — The list of chemical disinfectants is too extensive to be given in full here, and no attempt will be made to describe any but those in common use in households and hospitals.

Formulæ and directions for their use are found in all standard text-books on nursing.

Chloride of lime is a common household disinfectant which is used in solid form for disinfecting vaults and cesspools, or in solution for drains, cellars, and woodwork. A very weak solution is sometimes used for the disinfection of clothing, which it also bleaches, but its action is destructive to all fabrics. The value of chloride of lime as a disinfectant is disputed.

Lime is one of the oldest disinfectants known; its use for sanitary purposes was obligatory with the Children of Israel during their wanderings. Mixed with water to the consistency of cream, it is an excellent disinfectant for excreta and vaults. By the addition of more water it is commonly known as whitewash, and is the best practical disinfectant for cellars or rough walls of any kind in houses, barracks, stables, poultry houses, and other outbuildings.

It is said that Lister's first observation upon cleanliness as a factor in surgery was, that after each whitewashing of the hospital wards, the number of cases of

erysipelas and suppuration diminished for a short time.

Sulphur is another disinfectant which has been used nearly or quite as long as lime, although of late years it has been demonstrated that sulphur is of little value as a disinfectant.

Sulphur dioxide is produced by burning the sulphur, the process for disinfection being commonly known as sulphur fumigation. The best sanitary authorities believe, however, that sulphur fumigation without the addition of moisture is worthless, while with moisture its value is very limited. Its chief value is in destroying mosquitoes and bed bugs. In old buildings infested with bed bugs, repeated fumigations with sulphur at short intervals will destroy them.

The fumes of sulphur tarnish all metals and discolor most fabrics, also leaving a disagreeable odor which persists for many days.

Permanganate of potassium is a disinfectant quite extensively used for the hands in surgical work, but it is not practical for the disinfection of excreta, and it stains all fabrics permanently.

Sulphate of copper is an effective germicide, but too expensive for practical purposes.

Bichloride of mercury (corrosive sublimate) is probably the most important chemical disinfectant known, but Harrington says, "it enjoys a reputation for practical efficiency that is not wholly deserved." Its especial value is in surgical work for disinfecting the skin, ligatures, and utensils. It corrodes metals and therefore cannot be used upon surgical instruments.

Bichloride of mercury is not suitable as a household

disinfectant unless used by persons of experience, as it is a violent irritant poison.

The mineral acids are disinfectants against all bacteria, but corrode all metals and destroy fabrics.

Hydrochloric acid, which is the acid contained in the gastric juice, has been found effective in destroying both the cholera and typhoid fever bacilli.

Sulphuric acid also is effective with cholera and typhoid fever germs, but neither is of any value for disinfecting in cases of tuberculosis or diphtheria; neither acid therefore is practical for general use.

Carbolic acid (phenol), one of the best-known and commonly used disinfectants, is a substance obtained from coal tar. According to some of the best authorities the crude acid is a better disinfectant than the more refined grades, because it contains a higher percentage of the cresols. Authorities differ greatly in their estimate of the value of carbolic acid as a disinfectant, but it is conceded to have some qualities preferable to corrosive sublimate; it does not corrode metals, and even in a weak solution it kills many pathogenic bacteria.

The cresols are substances contained in carbolic acid, and of recent years have been extensively used in various preparations, the most common being *creolin, crenosol,* and *lysol,* all of which are used satisfactorily in surgical work.

Alcohol is much used as a disinfectant in surgical work, and as a preservative of organic substances.

Soaps of all kinds are disinfectant and antiseptic. It has been demonstrated that a 10 per cent solution of good soap would destroy the bacilli of typhoid fever,

a stronger solution being necessary for cholera bacilli, while for the pus cocci (germs) it was entirely ineffective with a 20 per cent solution. For practical purposes, however, soap could not be the sole disinfectant used upon the bed and body linen of typhoid fever or cholera patients, as the ordinary procedure in laundries would not insure certain results, and again such linen must be wet with some disinfectant immediately upon its removal from the bed, not only as a protection to nurses and others who must necessarily handle it, but to prevent any pathogenic bacteria from becoming dried and blown about.

The tincture of green soap is used almost exclusively in all hospitals for sterilizing the hands or the field of operation, as it is conceded to be the best soap known for the purpose.

The value of soap in the process of room or household disinfection is not wholly realized.

In the disinfection of woodwork and furniture, soap may be used where corrosive sublimate, carbolic acid, and many other disinfectants would be destructive to the fabric or finish. One factor in the use of soap which nurses and housekeepers recognize, is that it dissolves and *removes* the accumulated dirt upon the surfaces of objects, an office which corrosive sublimate and other disinfectants do not perform.

The furniture contained in living and bed rooms, by constant handling and the accumulation of dust and soot, becomes very dirty in a short time. By the use of a strong, warm soapsuds (20 per cent), and the addition of an ounce of petroleum to each gallon, the finest mahogany or rosewood surfaces may be washed with no

injury to the polish, and an astonishing amount of dirt be removed, which would appear to be a much more effective disinfection than simply wiping the surfaces with a cloth, damp with a weak solution of some disinfectant.

The addition of an ounce of washing soda to each gallon of *hot* soapsuds used upon floors after an infectious illness or in the case of very dirty wooden floors will also remove as well as disinfect the filth, which is the desired end in view.

The very noticeable escape from infection which the hospital scrub-maids seem to enjoy, would certainly tend to confirm the claims of soap as a disinfectant.

Many medicated soaps upon the market claim great disinfectant powers, but the best authorities do not find them of any greater value as disinfectants than the ordinary soaps.

Abbott gives a formula for a Carbol-soap which is easily made and used and of great value for the disinfection of bed and body linen.

"Dissolve 3 parts green soap in
100 parts of warm water, add
5 parts commercial carbolic acid, stirring slowly.

"This forms a permanent solution and has about the same disinfectant value as the pure carbolic acid."

Formaldehyde is a gas which dissolved in water gives a solution of about 40 per cent formaldehyde, called formalin.

Formalin is the form most commonly used for disinfecting purposes.

Formaldehyde is considered the most valuable known

disinfectant for room disinfection following all infectious diseases; it is also a deodorizer; it does not tarnish metals nor discolor fabrics; the gas is not poisonous, but is extremely irritating.

Disinfection of Infective Materials.

Excreta: Carbolic acid 5 per cent;
or Chloride of lime 2 per cent;
or Milk of lime (lime and water, consistency of cream);
or Bichloride of mercury 1 ounce,
Hydrochloric acid 10 ounces,
Water 1 gallon.

In all cases the disinfecting solution should equal the excreta in bulk, and the mixture closely covered be allowed to stand some time before emptying.

All vessels used for stools, sputum, and vomit should be washed in carbolic acid 5 per cent, followed by scrubbing in hot soapsuds and by boiling in soda solution 3 per cent.

Clothing. — Bed and body linen, towels, napkins, wash curtains, bureau and stand covers; soak in cold Carbol-soap solution (p. 159) for two hours, rinse in clear cold water, and put into the laundry.

Woolen garments, unless badly infected, may be fumigated with formaldehyde, followed by exposure to sunlight. Otherwise heavy garments, carpets, rugs, furs, woolen curtains, together with children's playthings and books, should be put into compact bundles wrapped in cloths wet in

carbolic acid 5 per cent or bichloride of mercury 1:1000, and burned in a furnace.

Utensils. — Dishes and silver may be boiled for 20 minutes in soda solution 5 per cent, also wash-basins and other toilet dishes, besides all surgical instruments, nail files, and manicure scissors.

Toothbrushes should not be used during infectious illness, but the mouth and teeth cleaned with small mouth sponges and toothpicks wrapped with absorbent cotton, both to be burned immediately.

Furniture. — 1. Fumigation with formaldehyde.

2. Wipe with cloth wet in carbolic acid 5 per cent followed by washing with a 20 per cent warm soapsuds containing 1 ounce of petroleum to each gallon.

3. Expose to sunlight for several days in succession if possible, turning all sides to the sun; turn upside down as well.

Walls. — 1. If papered, wet *thoroughly* with bichloride of mercury solution, 1:1000, remove paper, being very careful to keep the paper wet.

2. Fumigate the room and follow by opening all windows and doors for twenty-four hours.

Floors. — 1. Wet with bichloride of mercury solution 1:1000 before fumigation.

2. After fumigation, scrub with 20 per cent *hot* soapsuds to which has been added 1 ounce of washing soda to each gallon. This first cleaning should be done with a broom and mop that the water may be as near boiling as is possible.

Woodwork. — 1. Wet with bichloride of mercury 1:1000 before fumigation.

2. After fumigation, wash as directed for furniture.

In several cities laws have been enacted requiring public libraries and conveyances to be disinfected, and in some cities barber shops are under inspection regarding their daily care.

TEACHER'S NOTE. — All schools should be provided with the circulars of information issued by the boards of health concerning the medical inspection of schools and the management of contagion. In the country, smaller cities, and towns, reprints of these circulars may be obtained for the use of schools.

QUARANTINE

Dr. Walter Wyman of the United States Marine Hospital Service defines quarantine as "the adoption of restrictive measures to prevent the introduction of diseases from one country or locality into another."

The term is broadly used, and by usage includes port, land, interstate, municipal, railroad, house, and room quarantine.

The necessity for restrictions in certain diseases has been recognized from the earliest times, leprosy probably being the first disease for which isolation in any sense was practiced.

The first maritime or port quarantine was established in 1403 in Venice, and all ships and persons coming from Egypt or other countries, suffering from the plague, were detained for forty days in quarantine; this practice gradually extended until it was realized that such wholesale arbitrary measures were unreasonable and imposed

so much injury upon commerce that more rational restrictions were gradually made.

The United States government maintains quarantine stations at twenty-eight seaports. "Maritime quarantine consists of the detention of the infected ship, the isolation of the sick in a special hospital at the quarantine station, the disinfection of the ship and its cargo as well as the clothing and bedding of the well, the detention of all well persons in barracks until after the period of incubation of the particular disease has elapsed and all danger of dissemination has been eliminated. The period of detention, the mode of disinfection, as well as all the other prophylactic measures employed, will depend entirely upon the character of the disease, its period of incubation, and the nature of the ship's cargo. The disinfecting agents commonly employed are superheated steam and formaldehyde." (Bergey.)

Inland quarantine is used in time of epidemics in certain localities, as in the case of yellow fever in the Southern States. When an epidemic extends over a number of states, the quarantine becomes interstate and is under the jurisdiction of the United States Treasury department, which obviates the confusion which might arise from conflicting laws in the various states.

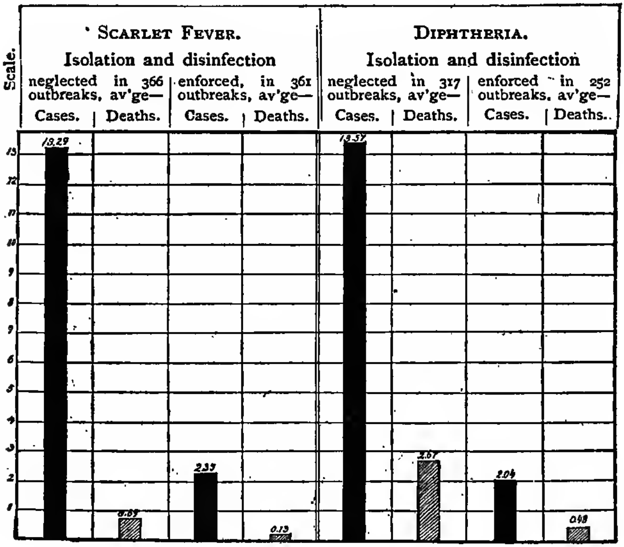
House quarantine is employed against smallpox, scarlet fever, diphtheria, cholera, typhoid and typhus fevers, yellow fever, and leprosy.

The patient should be isolated from the rest of the family, and other persons residing in the house should be forbidden attending school or business, or entering any public assembly or conveyance.

None but those in charge of the patient should be

allowed to enter the house, and the board of health is required to placard the house, the placard to remain until the patient has recovered or died and the house has been disinfected.

The following table reproduced from the proceedings of the Michigan state board of health is convincing proof of the value of isolation and disinfection: —



Each state has a right to quarantine, but the Federal government may assume control when the quarantine interferes with interstate commerce.

The board of health of each state not only enacts regulations for quarantine in case of infectious diseases, but for controlling all conditions which may be detrimental to the public health, such as the disposal of

garbage, sewage, the regulation of slaughterhouses, burial of the dead, and pollution of water by refuse from manufacturing.

The disposal of the dead is accomplished by burial or cremation, the laws varying little in the various states.

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